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OF THE

National Fire Protection Association

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National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

January, 1919

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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

The Exposure Hazard

Courtesy Whittlings.

It is not the individual or "unit" fire that is the principal factor in the enormous aggregate of the fire waste; it is the fire that passes from the building in which it originates into other buildings by means of unprotected window or door openings. This is what underwriters call the "exposure hazard." This hazard can be so reduced in the built-up sections of our cities as to make a down-town conflagration practically impossible by the fitting of window-openings with metal window frames and wired glass. To remove wooden window frames and wooden trim from buildings in the down-town section and install metal frames would be well worth the money it would cost when the possible losses due to a sweeping fire are considered. Some years ago Atlanta, Georgia, amended its building code to require that every new building erected within thirty feet of another building should have its window openings thus protected. If this regulation is being observed, the business center of Atlanta will some day be almost conflagration-proof.

The Quarterly

Vol. 12 January, 1919. No. 3

Seattle Dock Fire. On another page of this issue will be found a report of the $1,400,000 dock fire which occurred at Seattle on October 15, 1918. This report will be of special interest to members who recall the frontispiece and editorial in the October issue, criticising the conditions under which Oriental oils were being stored on the Pacific Coast. The news of the fire came just too late for reference in the October QUARTERLY, but it justifies in a very striking manner the misgivings then expressed as to the hazards of such storage. Although the dock which was destroyed was a different property from that shown in the QUARTERLY, the general conditions were very similar. The fire department did splendid work, but had a hard fight to get the flames under control, notwithstanding that wind and weather were on its side. Under less favorable circumstances there would almost certainly have been a disastrous waterfront conflagration.

* * * * *

Nomenclature. In presenting the first report of the *Committee on Nomenclature* in 1917, Mr. D. Everett Waid expressed the hope that the members of the Association would not be too much impressed by the profound wisdom of the Committee when they read in its report of the "orismology" of fire protection. Some of the definitions then presented have since been adopted by the Association, but there is plenty of evidence that the Committee's findings have not yet been made generally effective. The Committee has no means of giving currency to its definitions except through the co-operation of the membership, but standardization of the use of fire protection terms is undoubtedly a consummation devoutly to be wished. If practical difficulties are experienced in the application of any of the approved definitions, the Committee would, we believe, be glad to know of such cases. In one instance, at any rate, there seems to be pretty complete agreement, viz., that "fire-resistive" is a more accurate term than "fireproof." Yet many members still use the old word from force of habit. We suggest as a good resolution for 1919 that members who have not already done so should decide to abandon once and for all the word "fireproof" as an adjective.

Fire Prevention Progress in Canada. The inauguration of the Ontario Fire Prevention League under the direction of the Provincial Fire Marshal's Office has been followed by the formation of a very similar organization in British Columbia, and it seems very probable that in the near future all the provinces will come into line. The next step will be the federation of the Provincial Leagues into an organization covering the whole of the Dominion. This method of propaganda and public education is already having beneficial results in Ontario, and the development of the movement bids fair to place the United States in the first place, instead of the second, among the nations of the civilized world in the size of its per capita fire waste.

* * * * *

Police Training Schools in Cleveland. Member Charles H. Patton sends particulars of a very interesting scheme recently adopted in Cleveland for the training of the police officers to do educational work in fire and accident prevention. With the co-operation of the Board of Education and the Fire Department, the Chief of Police has instituted a training school in which the members of his department may become proficient in the setting-forth of instructions for school children, the observance of which should result in a marked decrease in the number of accidents and fires. It is planned to have regular monthly talks given in the schools. The idea is one which might well be given a trial in other cities.

* * * * *

Fire Hazards in Ships. With an appreciative note on Mr. Samuel D. McComb's article on "The Fire Risk on Vessels," published in the October QUARTERLY, member Howard E. Bligh of Calgary encloses the press clipping reproduced herewith:

> VICTORIA, B. C., Nov. 18.—Their vessel in flames when thirty miles away from the nearest land was the perilous future opened to Captain J. Johnson and four fishermen, all of Seattle, when off the west coast of Vancouver Island in the storm of Nov. 7-10. The steamer Princess Maquinna arrived this morning with the rescued men.
>
> Thirty miles off Cape Beale, at 3 a.m., on Nov. 7, a lamp in the galley of the Lief B. overturned and set the pilot house on fire. The men found themselves unable to control the flames, and fearing an explosion from the seven hundred gallons of gasoline on board, they took to a dory in their underclothing. There was no opportunity to secure a supply of food, and a cabbage and some apples was all they had.
>
> Blown out of their course by the storm, they were driven to the banks of Clayoquot Sound, beaching their dory at Refuge Cove. Their hands almost frozen and blistered by the burning oil, assistance was received at the camp of the Tidewater Copper Company.
>
> Capt. Johnson lost everything, the vessel representing the savings of a lifetime, being valued at $12,000.

Unquestionably there is a great work waiting to be done not only in the investigation and safeguarding of hazards on the big passenger liners, but also in the protection of those smaller craft which handle so large a part of the world's water-borne traffic.

* * * * *

Tests of Sensitiveness on Matches.

The Bureau of Explosives (Member N. F. P. A.) recently made some tests of the relative sensitiveness of a number of brands of strike-anywhere matches. The matches were subjected to friction on cylinders made of alundum, which is a refractory material obtained by mixing bauxite with ceramic materials and heating to a high temperature. The conditions of the tests were such that the only variable feature was the pressure of the match on the cylinder. The following observations taken from the latest Annual Report of the Bureau are of special interest to fire preventionists:—

Ten matches were subjected to test at each pressure varying from 5 grams upward. Above 10 grams the tests were made at 10 gram increments. The series for each match was carried on until a lower limit pressure was obtained, where there were no ignitions in twenty trials and an upper limit where there were ten ignitions in ten trials.

The lowest pressure causing ignition is reported, also the average pressure causing ignition. This latter figure is obtained by multiplying the number of ignitions at each weight, by the number of grams, adding all the products, and dividing by the total number of matches subjected to test. The temperature of ignition was determined by placing ten match heads in a glass test tube ⅝ x 5 inches. This test tube was lightly closed with a cork stopper and placed in an oil or parafine bath at an initial temperature of 100° C. The temperature was raised at a rate of 5° C. per minute. The temperature of ignition of each lot of matches was readily observed, with exception of one lot which would not ignite at all under this test. Owing to gradual distillation and oxidation of some of the constituents the temperature of ignition of this sample was determined in an open oven. The results are tabulated as follows:

No. of Sample	Minimum Pressure for Ignition	Average Pressure for Ignition	Temperature of Ignition
10053	10 grams	16 grams	158-159° C.
10054	10 "	131 "	171-173° C.
10055	20 "	23 "	156° C.
10056	50 "	60 "	166-168° C.
106'1	20 "	58 "	165-167° C.
10692	20 "	48 "	163-164° C.
10694	10 "	13 "	162-163° C.
10695	No ignition with maximum weight of 500 grams,		82° C.
10696	10 grams	31 grams	179-181° C.
10697	20 "	40 "	164-167° C.
10698	20 "	25 "	173° C.
10699	20 "	41 "	162-165° C.
10700	20 "	20 "	152-154° C.
10702	5 "	18 "	165-166° C.

The above results show at once that there is little relation between the sensitiveness to friction and the temperature of ignition. Sample No. 10695 gave a temperature of ignition of 82° C. which is abnormally low. A box containing approximately 500 of these matches was placed in an oven heated to a temperature of 93° C. (200° F.) They ignited in 15 minutes. The shipment of

these matches is therefore prohibited by the I. C. C. Regulations, Paragraph 1836 (d).

The ignitions at each weight of the various matches have been plotted on plotting paper in order to show graphically the differences in sensitiveness and uniformity in the various matches tested. It is considered that the average friction test is of significance with regard to safety, as well as the minimum friction test. The difference between these two figures is a measure of the uniformity of the product.

If desirable it will be possible to differentiate between two lots of matches showing the same sensitiveness on the above test. This can be done by using another grade of alundum cylinder, which has a smoother surface than the ones now used, and hence the matches will require higher pressures to produce the same friction.

It will be noted that seven of these brands of matches show a minimum test of 20 grams with three above this figure, and four below it.

With the present methods of packing matches for shipment, sensitiveness is one of the factors in determining the hazard. By reducing the sensitiveness the fire hazard in transit will be reduced. The use of this test or some similar one for determining the sensitiveness of matches is suggested with a view to establishing a minimum test for matches acceptable for transportation.

* * * * *

Hazards of Naphtha Soap.

Also from the Bureau of Explosives comes the following instructive report on the fire hazards of transportation of naphtha soap:

A number of cakes of naphtha soap were purchased from a local dealer in order to make tests regarding possible fire hazards in connection with this soap in steamship transportation.

This soap is of a yellowish color, and has an odor resembling kerosene or naphtha. It is made up in the form of rectangular blocks 1⅜ x 2⅞ x 4⅞ inches. Material purchased was of rather soft consistency and the cakes could be readily dented by the pressure of the fingers. The average weight of the cakes was 265 grams each (approximately 9½ ounces).

The soap was dissolved in warm water, decomposed by sulphuric acid and distilled with steam. By this means 5.52% by weight of naphtha was distilled off. This naphtha had a specific gravity of 0.7699 at 60° F. and had a flash point of 80° F.

Two cakes of the soap in the regular wrappings, of two sheets of paper, were placed in a tin bucket of one gallon capacity. This bucket was provided with a tightly fitting "push in" lid, such as is used on paint buckets and cans. The bucket and contents were then placed in an incubator oven maintained at a constant temperature of 104° F. and kept there for four hours. The lid of the bucket was then removed and a lighted match lowered into the bucket but there was no flash or explosion of vapor. Two additional cakes of the soap were then placed in the bucket which was then securely closed and returned to the incubator oven. After 16 hours more at this temperature of 104° F. the lid of the bucket was opened and a lighted match placed at the opening. A strong flash of flame from the vapor in the bucket was immediately observed.

As a result of this test it is considered possible that a large amount of Fels naphtha soap or other naphtha soap, if kept for some days in a tight compartment of a ship, might readily give off enough vapors of naphtha to produce an inflammable or explosive mixture within the compartment. The ignition of this mixture might produce serious damage.

In view of these facts the present ruling of the Department of Commerce as to the stowing of naphtha soaps on passenger steamers is justified. The stowing of such material in ventilated compartments is considered safe. Owing to the difference in conditions railroad shipment of Fels naphtha soap is considered non-hazardous.

The Department of Fire Record. The study of japan and lacquer hazards which appears in the Department of Fire Record is the second experiment in a new type of fire record, the first being the study of fuel oil fires published in July, 1918. While it is not proposed to abandon the old method of studying the hazards of various properties according to class, the field for useful work along that line is obviously narrowing as the characteristics of the larger classes become better known. Opportunities for investigations with a different slant will, on the other hand, present themselves with increasing frequency. Suggestions from members for new studies or new methods of approach will receive a ready welcome.

* * * * *

The Purpose of Sprinkler Equipment. A few months ago we had occasion to comment upon the action of the proprietors of certain wool warehouses in Boston, who at a time when the conservation of wool was of the utmost importance dismantled their sprinkler equipment because they could not obtain free sprinkler leakage insurance. A somewhat similar condition of mind is revealed in the answers given by 53 concerns handling large quantities of foodstuffs to a well-known firm of fire prevention engineers which enquired of them what they considered the greatest benefit derived from their sprinkler equipment. By 28 concerns the reduction of insurance premium was frankly avowed to be the chief value; of the remaining 25, 22 attached most importance to the prevention of business interruption, while 3 gave first consideration to the safety of their employees. Seventeen other firms declined to distinguish between the three classes of benefit. It is encouraging to know that at a moment when a great part of the world is facing famine only 53% of the dealers who gave definite answers considered it more important to reduce insurance premiums than to conserve their products. It would be interesting to learn how far the replies of the other 47% were influenced by war-time patriotism and what proportion of them admit the permanent obligation of good citizenship to prevent the destruction by fire of the material bases of human life.

1918 Fire Losses $317,014,385.

From the Journal of Commerce

The losses by fire in the United States and Canada during the calendar year 1918 reached the enormous sum of $317,014,385. This is the largest amount for any one year in the history of the country, with the exception of 1906, the San Francisco conflagration year, when the total was $459,710,000. The fire losses for the year just closed were approximately fifty million dollars in excess of those of the preceding year. While this increase is very large, it is to a very great extent due to the higher values prevailing, and fire underwriters believe when the complete details of 1918's record are available it will be found that the actual destruction of property, aside from war munition works, was less than in the preceding year.

The following table gives the fire losses by years during the past forty years, and while there have been some declines it will be noted that the increase in general is very marked. This, however, is largely, if not wholly, accounted for by the pronounced gain in the country's value of property exposed to fire hazard:

Fire Losses During Past Forty Years Aggregate $6,762,966,045.

1918	$317,014,385	1898	$119,650,500
1917	267,273,140	1897	110,319,650
1916	231,442,995	1896	115,655,500
1915	182,836,200	1895	129,835,700
1914	235,591,350	1894	128,246,400
1913	224,728,350	1893	156,445,875
1912	225,320,900	1892	151,516,000
1911	234,337,250	1891	143,764,000
1910	234,470,650	1890	108,893,700
1909	203,649,200	1889	123,046,800
1908	238,562,250	1888	110,885,600
1907	215,671,250	1887	120,283,000
1906	459,710,000	1886	104,924,700
1905	175,193,800	1885	102,818,700
1904	252,554,050	1884	110,008,600
1903	156,195,700	1883	110,149,000
1902	149,260,850	1882	84,505,000
1901	164,347,450	1881	81,280,000
1900	163,362,250	1880	74,643,400
1899	136,773,200	1879	77,703,700

The losses by fire during 1918, considered by months, show that the increase in the total losses was mainly due to the records of certain months, notably October. The following table affords a monthly comparison of the losses during the past three years—1916, 1917 and 1918:

	1916.	1917.	1918.
January	$21,423,350	$36,431,770	$37,575,100
February	24,770,770	29,587,660	20,688,155
March	38,680,250	17,523,000	20,213,980
April	12,681,050	18,597,225	20,108,900
May	15,973,500	24,968,800	20,545,900
June	12,247,500	15,513,270	24,890,600
July	23,013,800	16,143,050	24,537,000
August	10,745,000	21,751,100	31,476,650
September	12,244,625	13,814,490	13,434,300
October	17,701,375	26,384,450	75,412,300
November	19,898,450	20,198,025	12,333,750
December	22,063,325	26,360,300	15,737,750

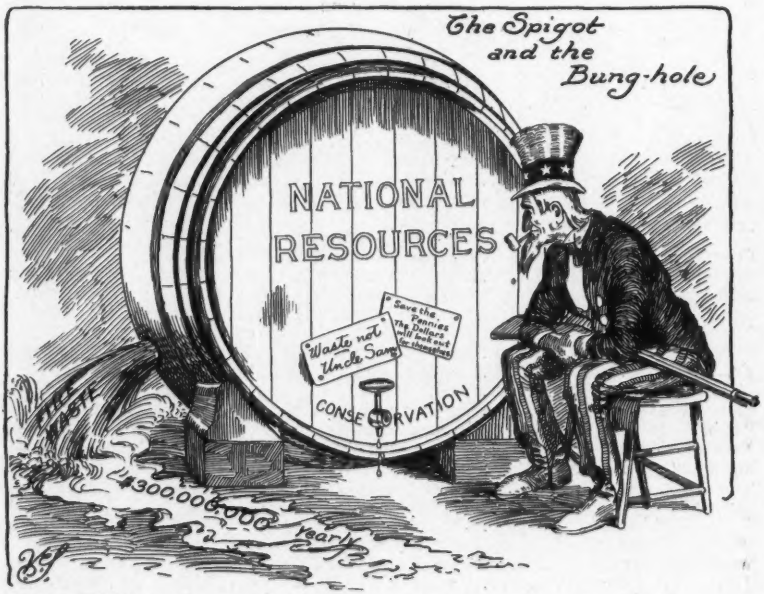
There were during 1918 some 2,943 fires which in each instance caused property damage to the extent of $10,000 or over. This is a marked decrease from the record of the previous year and, with one exception, 1916, is the smallest number of fires of $10,000 or over since 1903.

The largest fire during 1918 was that in Minnesota during October, which wiped out several counties of forests and destroyed several towns, causing a total loss of $35,000,000. There were during the year no less than seventy fires each of which caused estimated property damage of $500,000 or over. A list of these large fires of the year is given below:

Conflagrations of 1918.

Location.	Description.	Amount.
Buffalo, N. Y.	Notion store and other	$500,000
Niagara Falls, N. Y.	Hotel	500,000
Winnipeg, Man.	Business block	750,000
Indianapolis, Ind.	Several business houses	1,000,000
New York City	Loft building	500,000
New York City	Grain warehouse	500,000
Camden, N. J.	Two machine factories	500,000
Curtis Bay, Mich.	Shipbuilding plant	500,000
Peterboro, Ont.	Business section	500,000
Marquette, Mich.	Alcohol refining plant	500,000
Hoboken, N. J.	Steamer and cargo	500,000
Wayne, N. J.	Three powder mills	500,000
Hershey, Pa.	Chocolate factory	500,000
Benton Harbor, Mich.	Four business blocks	500,000
Greenwood, Miss.	Cotton warehouse	750,000
Saskatoon, Sask.	Hardware store and other	600,000
Johnstown, Pa.	Business district	1,000,000
Jersey City, N. J.	Warehouse and other	2,000,000
Oyster Bay, N. Y.	Dwelling	500,000
Kansas City, Mo.	Manufacturing district	2,500,000
Hammond, Ind.	Railroad car factory	517,000
Vermillion, Alberta	Business section	500,000
Toronto, Ont.	Stock yards	820,000
Lima, O.	Railroad shops	500,000
Parsons, Pa.	Tin plate factory	500,000
Burlington, Va.	Chocolate factory	1,000,000
North St. Louis, Mo.	Packing plants and other	2,225,000
San Francisco, Cal.	Aeroplane factory	750,000
Charleston, W. Va.	Railroad freight houses	750,000
St. Louis, Mo.	Government warehouse	3,000,000
Noxen, Pa.	Tanning plant	2,250,000
Chicago, Ill.	Stock yards	1,000,000
Emporium, Pa.	Tanning plant	500,000
Pembroke, Ont.	Business section	1,000,000
Mount Union, Pa.	Chemical works	900,000
Beaumont, Tex.	Shipyard works	750,000
New York Harbor	Steamer and oil cargo	3,000,000
Jacksonville, Fla.	Chemical works	1,250,000
St. Louis, Mo.	Wholesale grocery house	500,000
Oswego, N. Y.	Flour milling plant	500,000
Pembroke, Ont.	Several business houses	500,000
Provo City, Utah	Woolen mills	500,000
Moreau, N. Y.	Bag and paper plant	500,000
Montreal, Que.	Biscuit factory and other	500,000
Fresno, Cal.	Business section	500,000
Marianna, Ark.	Business section	750,000
Owensboro, Ky.	Whiskey distillery and warehouses	4,000,000
Canton, O.	Business block	1,000,000
Hillsgrove, R. I.	Iron works	500,000

Omaha, Neb.	Lumber and coal yards	$500,000
Chicago, Ill.	Milling plant	500,000
Lincoln, Neb.	Lumber yards and grain elevator	500,000
Camden, N. J.	Shipbuilding plant	600,000
Frankford, Pa.	Chemical works	500,000
Morgan Station, N. J.	Munition plant	20,000,000
Trenton, Ont.	Chemical plant	5,000,000
Seattle, Wash.	Oil and railroad docks	1,800,000
Minnesota	Forest fires	35,000,000
Fort Smith	Wholesale grocery and other	500,000
Brockville, Ont.	Carriage factory	710,000
Marblehead, Mass.	Aeroplane plant	500,000
Bristol, Va.	Business section of town	500,000
Baltimore, Md.	Piers, ships and gasoline tanks	1,000,000
Minneapolis, Minn.	Shell plant	500,000
Philadelphia, Pa.	Sugar refinery warehouse	500,000
Middletown, N. Y.	Dry goods store and other	500,000
Sapulpa, Okla.	Cotton gin and cotton	730,000
Joplin, Mo.	Business section	1,000,000
Bristol, Va.-Tenn.	Five business blocks	1,500,000
Bethlehem, Pa.	Several business blocks	500,000



Courtesy Whittlings

Fire and Accident Prevention Day, 1918.

It would be difficult to imagine conditions more unfavorable to a successful observance of Fire and Accident Prevention Day than those which prevailed in 1918. A change from the usual date, October 9th, was probably inevitable after the dates had been fixed for the Fourth Liberty Loan Campaign, but the selection of a Saturday—November 2nd—in substitution was in some cities considered unfortunate, as on that day of the week exercises in the schools are not practicable and department store co-operation is not readily obtainable. However, great efforts were made to overcome these difficulties, and with the help of the "Four Minute Men," notes for whose speeches were prepared by the National Board of Fire Underwriters, it was hoped to make a good showing. Then the influenza epidemic swept over the country, and in many places schools were closed and public meetings under ban on November 2nd. Some plans had to be altogether abandoned and others were a second time postponed. In Canada November 2nd was open to the same objection as October 9th in the United States, and accordingly such observance as was permitted by King Influenza took place on the earlier date.

As usual, the State Fire Marshals were active. State Fire Marshal G. Chal Port of Pennsylvania, whose untimely death during the epidemic is a heavy loss to the fire prevention movement, issued a number of very effective posters showing photographs of hazardous conditions with appropriate comments in red and green ink. In Ohio special efforts were made to reach the individual. Circulars were sent by Fire Marshal T. Alfred Fleming to the mayors of the cities, the fire chiefs, the teachers and educators, and the ministers of the State, giving them concrete suggestions as to the ways in which they might best take part in the propaganda. Thousands of cards, convenient for carrying in the pocket, were distributed through schools, industrial plants, and civic and other organizations. On one side these cards bore thirty suggestions for preventing home fires, and on the other a list of striking facts about the fire and accident waste. Special articles were prepared for trade, religious and other journals, and the co-operation given by the newspapers was very satisfactory. Mr. Fleming feels that, notwithstanding the abandonment of public assemblies on account of influenza, more educational work was accomplished than in any previous year. Insurance Commissioner James R. Young, of North Carolina, reports that he was prevented from doing as much as usual in connection with Fire and Accident Day, but, like Fire Marshal Fleming, he is laying great stress on the necessity of preventing fires and accidents *every day*. In this he is receiving assistance from commercial associations and women's clubs as well as the North Carolina Safety Leagues. An attractively bound "Fire

Prevention Day Booklet," incorporating ideas drawn from N. F. P. A. literature and many other sources, was published by State Fire Marshal W. M. Campbell of Louisiana. Some excellent press publicity was obtained in Indiana by Fire Marshal H. H. Friedley, who also made an appeal to the mayor of each city to appoint a special committee to supervise the local observance. The following personnel was suggested for the proposed committees: The mayor, one or two business men, one insurance man, the superintendent of schools, the fire chief and the president of the local federation of women's clubs. Indiana was one of the states in which it was found possible to arrange a postponed celebration, and the week from November 18th to November 23rd was set aside for the purpose. Mr. Friedley was able to secure the services of the "Four Minute Men" during that week. Fire Marshal S. W. Inglish of Texas issued a special bulletin, and sent to all local fire marshals special questionnaires for the use of school children in making home inspections. These questionnaires were extensively used in such schools as were not closed for reasons of public health. It is interesting to note that Mr. Inglish pays a tribute to the local insurance agents, who took a more active interest in the movement than ever before. The President of the State Association of Agents, Mr. Craig Belk, is among the most ardent supporters of the progressive policies inaugurated by Chairman F. V. Bruns of the Fire Prevention Committee of the National Association.

Outside the United States two observances, in each of which the Fire Marshal's office played an important part, call for special notice. The newly formed Ontario Fire Prevention League, which is affiliated with the Provincial Fire Marshal's Office and of which Deputy Fire Marshal George F. Lewis is Secretary, helped to make October 9th a memorable day throughout the Province. A booklet of suggestions was published by the League, many parades and municipal "clean-ups" were held, and in all about 45,000 pieces of literature were distributed. The newspaper fraternity took an active share in the campaign, and the railways assisted by distributing window cards, by instructing every agent in Ontario to observe the day, and by holding meeting of their employees in the larger centres. Hawaii also did splendidly. Fire Marshal Delbert E. Metzger, in conjunction with the Board of Fire Underwriters of the Territory and the Chamber of Commerce, secured an amount of publicity that is simply amazing. Eighteen sheets each measuring 17 inches by 14 inches and containing a number of carefully pasted newspaper clippings were forwarded to the Executive Office of the N. F. P. A. to show what had been accomplished. In addition to numerous editorials and news items illustrated by local photographs, many very striking and ingenious advertisements of fire prevention were donated by public-spirited insurance men. Special full-page advertisements of the Chamber of Commerce Committee were issued also in poster form. For several days the largest crockery and household goods store in Honolulu had a window display showing model kitchen exhibits along the lines indicated in Captain Gasser's article in the October issue of the QUARTERLY (page 125). One hundred of the Association's official posters were ordered for use in the Territory, and although no big meetings could be held as

suggested on the posters, Mr. Metzger did not allow this to interfere with their use. He just filled in the blank space following the sentence, "Bring Your Family to the Big Meeting" as follows:

> The BIG MEETING should be held at your own home and Committees should be appointed, yourself Chairman, to investigate your Back Yard, Front Yard, Walks, Cellar, Garret, Closets and other places about the premises where any dangers may lurk.
>
> These are days to cut out the wastefulness of fires and accidents. The way to do this is to get everything in good order and keep it so. Eternal vigilance is the price of safety. But vigilance can be made a stimulating and healthful habit and a pleasurable avocation. Teach it and try it and see if you don't like its growth.

The above is of special interest in view of the fact that several orders for posters were cancelled when the spread of influenza made it apparent that there would be few "big meetings."

In two States—Massachusetts and Wisconsin—work of a similar character to that undertaken elsewhere by State Fire Marshals was accomplished by the Fire Prevention Commissioner and the State Industrial Commission respectively. Through the medium of scores of thousands of posters issued by Commissioner Frank Lewis, Greater Boston was most effectively reminded of the duty of fire prevention, and a mass meeting was held in the National Theatre on Friday, November 1. The Commissioner presided over the meeting, which was addressed by Secretary Wentworth. A number of N. F. P. A. members were present, including Vice-President Lacount and Mr. Gorham Dana of the Executive Committee. The Commonwealth was represented by the State Treasurer and the City by Mayor Peters. Prior to the meeting Chief T. G. Toomey held the annual demonstration of the fire protective equipment of the great store for the safety of which he is responsible, and a parade, including a goodly display of fire apparatus, was arranged from the demonstration to the meeting. Educational work was also done in the schools and factories during the preceding week. In Wisconsin the Industrial Commission issued a special handbook for the guidance of those desirous of observing the day, circularized factory service workers and factory nurses as to the importance of fire drills, and published a special bulletin on the prevention of mill and elevator fires.

Turning to the efforts of individuals and unofficial organizations, we find much ground for encouragement. A remarkable feat of organization was performed by Mr. Gilbert E. Stecher in Weehawken, Hoboken and Union Hill, N. J. Starting with every circumstance against him, he succeeded in obtaining a remarkable observance. For a week prior to November 2nd every theatre in Hoboken and Union Hill showed a fire prevention slide each night. On the night of November 1st a wagon bearing suitable inscriptions and carrying a large bell and a boy dressed in a devil's suit feeding a pot of red fire paraded the streets from 7.30 until 10 p. m. This was followed by a company of boy scouts who distributed fire prevention literature. The stunt was repeated on the following evening, with the addition of an automobile fire truck which paraded the streets all day inscribed with fire prevention arguments and warnings. Fire and accident prevention films were shown in all the theatres, 300 letters were sent out to the business men of Hoboken by

the Chamber of Commerce, and appeals were made to the churches. Permanent Fire Prevention Committees were established by the Hoboken Chamber of Commerce, the Women's Club of Hoboken and the Retail Merchants' Association of Union Hill.

In Chicago it was found impracticable to stage an observance of the usual character, but much valuable educational work was accomplished. Placards were distributed throughout the city; 15,000 circulars containing data for use in addresses or talks on fire and accident prevention were sent to public schools, parochial schools, clergymen and civic organizations; and 5,000 notices containing brief warnings concerning a variety of hazards were mailed to selected lists of citizens. Special drills were held in most of the factories possessing private fire brigades.

The city of Rochester, which has a tradition of fine observances, postponed its exercises to November 22nd in order to do the occasion justice. By that time the epidemic had moderated, and a large mass meeting was possible. Mr. H. W. Forster was one of the principal speakers. Talks by "Four Minute Men" were given in 25 leading industrial plants and in the theatres, and by representatives of the fire and police departments in the schools. Sixty thousand pieces of literature were sent into the homes of the city through the school children. Fire and accident prevention slogans were widely distributed and displayed. As in former years, the arrangements were in the hands of the Chamber of Commerce, but numerous other organizations co-operated.

The Chamber of Commerce at Niagara Falls, N. Y., held its postponed observance on November 15th and 16th. Mr. George W. Stone was chairman of the Committee responsible for the work. A large quantity of literature was distributed, including leaflets in Polish and Italian. A fire department parade was held on November 16th and fire and accident prevention films were shown in all the theatres in the city. The local "Four Minute Men" took part. School and church publicity was obtained and there were window displays of safety devices and fire-fighting apparatus in some of the hardware stores.

Interesting items are to hand from various other cities. Kansas City, Mo., and San Antonio, Texas, are reported to have held impressive parades on November 2nd. Newark, N. J., had an elaborate fire prevention exhibition along the lines of that described by Capt. C. Albert Gasser in the QUARTERLY for October. This comprised 43 separate illustrations requiring more than 400 lineal feet of corridor space; it lasted for two weeks, with November 2nd as the pivotal day, and was visited by thousands of school children, who took notes from which to write compositions. Oshkosh, Wis., continued its excellent record for good observances under the management of the Business Women's Club. Mr. E. L. Sanders planned a big educational campaign for Worcester, Mass., and also undertook to interest organizations with which he had influence in a number of the towns of the State. Although as a result of the epidemic the Worcester program could not be carried out except in the matter of newspaper publicity and the exhibition of a safety film, quite a little interest was aroused through Mr. Sanders' efforts in several towns.

It may be of general interest to note that an attempt was made to

interest the University members of the N. F. P. A. in the observance of Fire and Accident Day. Considerable sympathy with the project was shown by several of these institutions, and exercises were actually arranged for the Leland Stanford Jr. University, California. The military character temporarily assumed by most of the universities, however, made it impossible to accomplish much in this direction in 1918, but it seems probable that with the return of normal conditions more satisfactory results may be obtained in 1919.

A special Fire Prevention Day poster was issued by the United States Railroad Administration for use on railroad property and a telegram on the subject was sent by the Director General of Railroads to all Regional Directors and Federal Managers. The Mutual Fire Prevention Bureau, W. Reed, Manager, published an instructive circular which doubtless resulted in a reduction of hazards in the plants under its jurisdiction. A novel but quite effective method of drawing attention to the occasion was adopted by John Sutherland & Sons, Ltd., of Guelph, Ontario, who sent out small blotters bearing in bold red type the legend: "Fire Prevention Day, 9th October, 1918. Clean up."

The National Safety Council co-operated with the Association in the preparation for general use of a joint poster which was practically the same as the one found so successful in Chicago in 1917. The demand for the poster was, as already indicated, very adversely affected by the trying conditions prevailing on November 2nd.

Two or three needs are becoming increasingly clear: (1) the need for a larger number of up-to-date instructive fire prevention films; (2) the need for more or less standardization of methods of financing local observances, and (3) the need of a permanent standing committee in every large city which shall not only take care of arrangements for Fire and Accident Day, but shall be an instrument for the education of public opinion in regard to fire prevention matters at all times. It is hoped that during the coming year considerable progress will be made towards meeting these needs.

"Best Building" Competitions in Cleveland, Ohio.

Members who followed the Round Table Discussion on the planning of hotels and apartment houses for safety at the 1918 Annual Meeting will remember the instance cited by Mr. A. R. Small (Member N. F. P. A.) of an apartment house in Chicago which succeeded in winning a prize for beauty through the diversion into aesthetic channels of expenditure which might better have been devoted to fire protection. Even in that unusual case the building did not, of course, fall below the standards required by the city ordinances, and it might have been just as unsafe if it had been much less beautiful. Nevertheless the incident serves to draw attention to the need of emphasizing the fire safety feature in all competitions designed to promote public interest in the erection of worthy buildings. It is gratifying to notice that this need has been fully recognized by the City Plan Committee of the Cleveland Chamber of Commerce, under whose auspices competent juries are appointed to inspect the buildings completed each year in that city and to report upon the same with a view to the award of medals for the best factory, the best commercial building (limited to three stories) and the best apartment house.

An instructive illustrated report in connection with the awards made in 1917 in respect of buildings erected in 1916 has been issued in pamphlet form by the City Plan Committee, and a copy has been forwarded to the N. F. P. A. by member Charles H. Patton, who, as Chairman of the Fire Prevention Committee, has himself played an important part in awakening his fellow-citizens to their responsibilities. The object and scope of the competitions are set forth as follows:

> Few of us realize that the attractiveness of the city in which we live and for which we are individually and collectively responsible depends in large part upon the good taste, the sense of fitness and the harmony with its surroundings of each individual building. It is a matter of concern to every citizen that each new building shall be an addition to the city in charm as well as in utility. Buildings erected now will probably stand for fifty years or more. During that time they will delight or displease, perhaps unconsciously, thousands of citizens who pass them daily. Buildings are not only in themselves pleasing or displeasing, but they have a very important influence on the neighborhood in which they stand. It is possible by good example or by the discouraging influence of ugliness to alter the appearance of an entire district.
>
> Believing that the owners and builders of the different structures of the city desire to do their work well and to forward the interests of the city by the attractiveness, comfort, sanitation and safety of the buildings they erect, and desiring to assist them both by the power of a supporting public opinion and by the advice of trained specialists, the city plan committee has instituted a series of awards for the best building erected in Cleveland each year in three classes:

Apartment Houses.
Factories.
Commercial buildings of three or less stories.

The three classes of buildings considered are by no means the only important ones. The more monumental buildings, however, such as churches, libraries, auditoriums and schools, always receive the most careful artistic and scientific consideration in general design and detail, and criticism or encouragement of them is entirely outside the purpose of this committee. The apartment house and small commercial building, under which two classes much of the building at the present time in Cleveland falls, because of their number have a more determining effect upon the city's architectural beauty than the infrequent monument. Yet, because of its seemingly prohibitive cost in relation to the capital invested, these are more frequently built without than with architectural advice. It is hoped that it will be possible to show owners and builders that skilled designing will produce not only a more beautiful building, but a more commercially profitable one. Cleveland factories, it is needless to say, are generally efficient in the highest degree and compare in appearance, moreover, very favorably with those of any other city in the United States. It is for the encouragement of the increasing attention given by their owners and builders to beauty of proportion and setting that factories were made one of the three classes eligible for award.

The committee has preferred to make the award to the actual buildings rather than to drawings or plans. This is because the notice and interest of the city as a whole and of those erecting these three classes of buildings is more easily aroused and held by a completed structure than by drawings, and the purpose of the committee is to stimulate the interest of citizens and of builders.

The award will take the form of a bronze plate, suitably inscribed, which may be affixed to the building.

The following conditions were observed in the making of the awards:

1. Any building in the City of Cleveland is eligible for the award.

2. In all three classes the first award will be made on buildings which were in process of building in 1916, but were completed on or before January 1st, 1917. In order to secure a standard of completion, the date of the final official inspection by the building department of the City of Cleveland, as recorded by it, will be accepted in every case as the date of completion. Similar awards will be made for buildings in each class completed on or before January 1st of each succeeding year.

3. The composition of the juries, and their personnel differs in each case, will be as follows: two members on each jury will be architects appointed by the Cleveland Chapter of the American Institute of Architects, one member an engineer appointed by the Engineering Society of Cleveland, and one member a builder appointed by the Builders' Exchange of Cleveland. The fifth member on the apartment house jury will be a housekeeper appointed by the Cleveland Federation of Women's Clubs; on the jury for commercial buildings a department store manager appointed by the Retail Merchants' Board; and on the jury for factories a factory general manager appointed by the Manufacturers' and Wholesale Merchants' Board.

4. Awards for buildings in any of these three classes will be made only after personal inspection by the juries.

5. The committee, desiring to encourage certain qualities in design and construction of the buildings erected in the City of Cleveland, asks the juries to give particular attention to the following factors, the percentages varying in each of the three classes of building:

(a) Aesthetic Value:
Simplicity.
Proportion.
Artistic and practical use of inexpensive materials.
Adaptability of building to site and neighborhood.

(b) Adaptation of space to use—plan.
(c) Sanitation:
Fire Safety.
Light.
Ventilation.
Provision for thorough and economical cleaning.

It is perfectly clear from the report of the Sub-Committee on Medal Awards and from the findings of the three juries that the whole field was thoroughly surveyed and the medals awarded only to buildings which attained a really high standard of excellence. The findings of the jury on apartment houses are reproduced in full:

Findings of the Jury on Apartment Houses.

To the Sub-Committee on Medal Awards of the City Plan Committee of the Cleveland Chamber of Commerce.

Gentlemen: The jury appointed to award the Chamber of Commerce medal for the best apartment house completed in Cleveland during the year 1916 begs to submit the following report:

During the year 1916 the Cleveland Department of Buildings issued the final inspection certificates on 160 apartments. These were catalogued and distributed among the jury members for preliminary inspection and classification into groups according to merit. Each of the apartments receiving the highest rating was then visited and inspected by the jury as a whole.

As laid down in the program set by the sub-committee on medal awards, the buildings were scored on sanitation, on plan or the adaptation of space to use, and on aesthetic value.

The jury has carefully considered all of the apartments and finds several in which the items of sanitation and plan have been given creditable consideration. The various phases of sanitation being well defined and regulated by the building code were of equal value in several buildings. A surprising lack of variety in plans was discovered, the apartments in general being variants of one or two equally good typical arrangements. The most livable apartment was one situated on a wide and rather shallow lot and was planned so that living and dining rooms had unobstructed street views, the porches were well isolated, and the interior halls were short. In most cases the entrance halls lacked the size and dignity which should be given to buildings housing several families.

The jury finds a lamentable lack of aesthetic value in any of the buildings. Several of them possess creditable street facades, but the other visible sides are entirely lacking in commendable qualities. In no case were the side elevations built of the same materials used on the front, although they were perfectly visible from the street and of great importance in making the building harmonious. This contrast between fronts and sides became more marked and disagreeable when the fronts were elaborate. Few cases showed that the color scheme of materials had been selected to harmonize with the adjacent buildings. The use of meaningless ornament, poorly proportioned porches, clumsy, uninteresting cornices, uninviting entrances, and faulty fenestration was much in evidence, and the design of rear and side stairways leaves much to be desired. Few cases showed careful thought in the landscaping and planting of the grounds, and in many cases the apartments were not in alignment with their neighboring buildings.

Inasmuch as the awarding of a medal presupposes that the building is free from general criticism and is of a type which should be fostered in the community, the jury is of the opinion that, while one building may be the best of its class for a certain year, yet if it fails to meet the fundamental requirements of aesthetic value it should not be dignified by a medal.

The jury has not been harsh in its judgment, and regrets very much the lamentable fact that the skill displayed in designing and erecting apartments is not equal in any way to the quality of work found in the factory or commercial groups. In viewing the various buildings the jury found several examples built

preceding or subsequent to 1916 which in all probability would have been worthy of being premiated.

The jury having failed to find any example which is free from the harshest criticism, is unanimous in the opinion that the Cleveland apartment houses are doing less than any other class of building to enhance the beauty of our city, and therefore recommends with regret that no medal be awarded for the 1916 group of apartments.

Respectfully submitted,

George W. Beer, Chairman.
Mrs. E. H. Baker
F. R. Walker
Fred D. Richards
Henry Watterson
Jury on Apartment Houses.

December 13th, 1917.

Civic patriotism which is not afraid to use this sort of plainness of speech is one of the most valuable assets that any community can acquire. It would be quite unsafe to infer from the findings that the apartment houses of Cleveland are exceptionally poor structures: it would probably be more just to draw the conclusion that the standards of its citizens are exceptionally high.

The Human Factor in the Fire Service

By W. T. Colyer.
(Member N. F. P. A.)

Fire prevention engineers have been among the first to realize the importance of the human factor in relation to efficiency of watch service. By their unremitting efforts to protect him against the unfair competition of the infirm and the decrepit, they have proved themselves the best friends of the competent watchman. Not only have they urged that the service rendered by the watchman should be adequately compensated, but they have shown a keen and sympathetic insight into the conditions under which his work has to be performed. While they may not always have agreed as to the best methods of overcoming or mitigating the tediousness of the lonely watcher's job, they have at least presented a united front in opposition to the absurd and unjust notion still widely entertained that any fool is equal to the task of patrolling a deserted plant during the night silences, keeping the senses of sight, hearing and smell keenly alert for small variations from the normal and the mind ready to gage the significance of each variation and promptly to apply the appropriate remedy.

It would be a thousand pities if the men who have given evidence of so sympathetic an understanding of the watchman's lot should even seem to be antagonistic to the fireman through lack of appreciation of the human values involved. Signs are not wanting, however, that exactly this condition is likely to arise unless deliberate efforts are made to avert it. That there have been—and still are—grave faults among the rank and file of some of the fire departments is undeniable. Incalculable harm has been done by the little group of firemen's advocates

who inveighed by turns against all attempts to invest fire departments with any functions beyond actual fire-fighting and against all appointments of "non-firemen" to positions in fire prevention bureaus and similar offices; but no reader of the periodicals written by firemen for firemen can fail to notice how rapidly this old-fashioned attitude is being discredited. The firemen themselves now recognize that the future of the fire departments depends largely upon the development of fire prevention as a branch of the public service. Even from the narrowly personal point of view, the long periods of enforced idleness in the engine house seem to have lost what attractiveness they ever possessed, and the men are everywhere manifesting their desire for a richer and more satisfying life.

It is just at this point that something akin to antagonism between the fire-fighters and the fire preventionists begins to make its presence felt. Readjustments in matters of importance are hardly ever made quite smoothly, and where the problems involved are difficult and the life and property values at stake are enormous, it is to be expected that some false moves will be made and that there will be regrettable incidents. Unless, however, we are to assume the existence of a sort of influenza of the character that has spread through the fire departments of the country after the manner of a physical epidemic, we must proceed on the hypothesis that there is some rationally ascertainable cause for the widespread unrest among the firemen. Charges of complete selfishness and disregard for the public good are very easy to bring, but by no means so easy to prove, in the case of men who have been accustomed to turn out uncomplainingly at any hour of the day or night in any sort of weather and risk their lives for the safety of their fellow citizens. When strikes of fire departments occur in city after city, is it not reasonable to conclude that there is probably some general lack of sympathy and understanding in dealing with the men? In the writings of fire prevention engineers on city fire protection one certainly misses that fine appreciation of human values which is so noticeable a feature of their treatment of the watchman problem. The reason for this is obvious. In the consideration of the protection of an individual plant, the personal note is constantly to the fore—in housekeeping and management as well as in watch service. When it is a question of city protection, on the other hand, the natural tendency is to think in terms of machinery rather than in terms of human beings. The fire department figures in the reckoning as an aggregation of so many fire-extinguishing bipeds distributed thus and thus, in conjunction with such and such other apparatus. Discipline and personnel are, it is true, treated in an academic manner, but deviations from scientific theory into the hurly-burly of everyday life only occur when some flagrant irruption of politics compels attention to the resulting inefficiency.

The foregoing observations are not for a moment intended to imply that the present method of reporting upon cities could be improved by the inspecting engineer constituting himself a sort of "welfare worker" and interfering with discipline by visits to the engine houses to see whether the firemen seem happy.

In all professions, however, an attitude of mind purposely adopted for a specific end tends to perpetuate itself in connections to which it is unsuited unless it is thrown off as deliberately as it was assumed, and it is only human if the fire prevention engineer's view of the efforts of the firemen to improve their working conditions is sometimes affected by his habit of dealing constantly with fire departments simply as factors in larger fire protection problems.

During the past two years insurance and firemen's journals have been full of attacks and counter-attacks upon existing conditions and proposed reforms (notably the "two platoon" system) in the fire service, but it is surprising how infrequent have been the attempts to grapple with the problem as a whole. Imaginary martyrs alternating between deeds of heroism and incarceration in gloomy engine houses where they pined away for lack of home life have been set over against equally imaginary unpatriotic fellows, already privileged to spend most of their time in quiet enjoyment of their pleasant quarters, who were ready to let cities burn before their eyes if thereby they could secure some personal advantage—one side interested only to glorify the fireman, the other only to have the greatest possible proportion of the total force available for duty at any given moment. The subject needs more dignified and broader-minded treatment than this.

Some months ago an eminently dispassionate plea for the two platoon system was prepared by Captain J. F. McEnroe of the Springfield, Mass., Fire Department and three fellow officers. Their statement recognized the claims which the community has on the fireman as well as the claim which the fireman has on the community. They did not shirk the problem of finance, but adduced reasons for believing that substantial benefits would accrue to the city in return for the extra expenditure involved. They pointed out that increasing difficulty was being experienced in securing men of a good type to take service under conditions which kept them from the enjoyment of family life during four days out of every five; that while under the continuous service system the personnel of the various companies constantly varied as the different members took their fifth days "off," the adoption of the two platoon system would permit the development of better team work by making more specialization possible, as the same men would habitually be on duty together; that the physical health of the men, especially in winter, would be improved by giving them greater opportunities of outdoor exercise in their own time; that a greater degree of interest and initiative was to be expected of men on duty for comparatively brief periods at a time than from men who felt themselves tied to the engine house for several days continuously.

The following quotation from the statement is of interest as showing how the officers compared the existing conditions with those that would prevail under the two platoon system. In explanation of the reference to an addition of 63 men it should be mentioned that the Fire Commission was contemplating an increase of the Department to this extent in any event.

Continuous Duty System.

Practically 165 officers and men belong to companies actively engaged in fire fighting and are divided as follows:

4	Engine Co.'s	8 men each	32 men
1	" "	11 " "	11 "
2	Hose "	8 " "	16 "
6	" "	7 " "	42 "
6	Ladder "	8 " "	48 "
2	Squad "	8 " "	16 "
		Total	165 "

165 men receiving one day off in every five means 33 men off duty at all times. 33 men from 165 leaves 132 men.

132 men going to meals in 3 shifts means 44 men off duty 9 hours each day or 37½ per cent offtime. 44 from 132 leaves 88 men.

88 men on duty, divided among 21 companies, 37½ per cent of time gives 137 days of 24 hours each out of 365.

132 men on duty, divided between 21 companies, 62½ per cent of time gives 228 days of 24 hours each out of 365.

8 is the maximum number of companies responding to alarms, and

4 is the minimum number.

1 piece of apparatus generally goes on telephone calls. Many alarms during meal hours.

Each man is allowed 109½ days out of 365 for meal hours and days off.

The above figures are, of course, averages, and the actual strength of companies varies on the different days owing to more or less men on days off, and to the various methods and time of sending men to meals, but the fact remains that each of the 165 men is not immediately available for fire duty during 109½ days each year. Men report during meal hours to fires sooner or later, but it is the first efforts that count and decide whether the fire is to be controlled and extinguished with small loss or develop serious proportions.

To the above figures could be added church leave and other leaves of absence which would not be necessary under the Two Platoon.

Proposed Increase of 63 Men Under Continuous Duty System.

63 men receiving one day off in every five—12 3-5.
12 3-5 from 63 leaves 50 men.

50 men going to meals in 3 shifts—16 2-3.
16 2-3 from 50 leaves 33.

33 men divided among 21 companies on duty 9 hours each day or 37½ percent of time and

50 men divided among 21 companies on duty 15 hours each day or 62½ percent of time.

Proposed Two Platoon System.

Increase of 82 men and 2 District Chiefs.
Hose companies will have 5 men on duty at all times.
Engine companies will have 6 men on duty at all times.
Indian Orchard will have 10 men on duty at all times.
Ladder companies will have 6 men on duty at all times.
Squad companies will have 6 men on duty at all times.

4	Engine Co.'s	6 men each	24, at all times
1	" "	10 men each	10, at all times
8	Hose "	5 men each	40, at all times
6	Ladder "	6 men each	36, at all times
2	Squad "	6 men each	12, at all times
21	companies	Total	122 men

122 trained men on duty and
122 trained men as an available force in reserve and subject to call.

Comparison.

Continuous System at Present.	Two Platoon.
21 Co.'s=132 men on duty 62½% of time	21 Co.'s=122 men on duty all the time. Number could be increased to 244 in case of necessity.
21 Co.'s= 88 men on duty 37½% of time	
100%	

Adding 63 Men

21 Co.'s=182 men on duty 62½% of time
21 Co.'s=121 men on duty 37½% of time

100%

It may be that the "two platoon" system is not the ideal solution of the problems which are now causing such widespread anxiety, but, if not, there would seem to be urgent need for some alternative plan to be formulated by its critics. If the opposition to the system is motived by nothing better than a desire to save money or to secure a greater efficiency of protection than city authorities are willing to pay a fair price for, it is not difficult to understand the growing popularity of "two platoons," for, whatever may be its defects, this plan represents an effort to provide reasonably comfortable conditions of life for men engaged in an arduous profession. To keep in physical condition to bear the strains which any fireman may at any time be called upon to bear is always difficult, and the task is certainly not rendered easier by a system which involves an unusual degree of confinement indoors. Moreover, such confinement without useful occupation undoubtedly creates conditions favorable to the development of brooding discontent. Any system which helps the growth of pride and interest in the service among the rank and file must in the long run react advantageously upon public protection, but it is always possible that those who are primarily interested in the lot of the fireman may not give due weight to all the other considerations involved. The temper of the Springfield document already mentioned certainly does not suggest anything in the nature of fanatical devotion to a pet scheme, and if some method other than the "two platoons" would better serve the public interest while conserving the human values with which the advocates of that system are concerned, there seems no reason to suppose that it would not receive fair consideration in the fire departments.

The statistics recently published by the Bureau of the Census indicate that the lack of standardization which has been attended with such disastrous consequences in the matter of hose couplings is characteristic of the general arrangements made for fighting and preventing fires. The desirability of substantial uniformity in methods of appointment, rates of pay, conditions of service, determination of apparatus and water supply necessary, etc., will be generally admitted. At present efforts after standardization in various respects are being made independently by organizations which have different ends in view and which sometimes seem not to be as well disposed towards one another as could be wished. Readers of the October QUARTERLY (p. 150) will recollect how strongly Chief McDonnell of the Chicago Bureau of Fire Prevention emphasizes

the good results accruing in that city from the sympathetic contact between the fire prevention engineers of the fire prevention bureau and the men who are preparing to become officers of the fire department. When such mutual understanding is extended to the point of bringing fire prevention engineers and firemen together in the working out of a scheme which shall combine the highest efficiency of public service with a maximum of regard for the human rights of the fire-fighters, it will be a great day in the war upon the fire waste.

The Care of Public Records.

By James Sullivan,

Director, Division of Archives and History, University of the State of New York.

Courtesy of The American City.

The first object of a city or any other political unit when it is established and has records of its own should be the preservation of these records against destruction by fire. The theft of papers is not so very common, and the losses which our communities have suffered have been almost entirely by fire.

It is well known that church organizations and private business concerns make it their first object to see that their records are taken care of in vaults or fire-resistive containers. This, however, seems to be the last thing that our average communities are willing to do. People do not seem to realize the danger from fire; and even when they are made to realize it, they procrastinate about taking any action. The inevitable fire takes place, and then they lament about the carelessness of the past. They always seem to be willing to take a chance, and in the course of years the chances are usually against them and their records are destroyed.

The attitude of peoples on the other side of the Atlantic is in general very different. When the war broke out and the Germans were sweeping into France, the first thing that the people of the local communes did was to get their records into wagons and carry them to places of safety. They did this amidst shell fire, when death confronted them at every step. The regard in which they hold their records is evident from their being willing to face such danger in order to get their documents to places of safety. In this country, where no such dangers exist, we allow our records to remain in combustible wooden cabinets and in non-fire-resistive buildings.

Though there is a law on the statute books of the State of New York with reference to this matter, the enforcement of it is slow because the penalties imposed for noncompliance are small. Until we give the statute "more teeth," we shall continue to have fires in our cities, villages, towns and counties, which will destroy valuable records. When they are destroyed, the replacement of them costs

Courtesy American City

Sub-standard containers in buildings of combustible construction are of little service in preserving public records.

the political unit hundreds of times more than it would have cost to provide a fire-resistive safety container.

Village, city, county and town clerks are not individually responsible for the conditions which exist in their offices. The local boards, which have control of the appropriations, are the people on whose shoulders the blame is usually to be placed. They, in a measure, feel that they are acting in the interests of the citizens by keeping down the tax rate a small fraction of a mill, but by so doing they are placing their records in jeopardy. These boards are the most difficult to bring pressure upon, because each one of the members is inclined to hide behind his fellows and point to his neighbor as the one responsible for the failure to take action.

The clerks, however, are sometimes directly responsible for the loss of records. There are on file in the office of the Director of Archives and History at Albany reports of numerous instances in which the clerks have left their records out of the safety containers, so that when fires took place many of the records were destroyed. We have a report of one case in which the town clerk's office had a fire-resistive safe, but the town clerk failed to lock the doors. The fire took place, the safe fell, the doors opened, and its contents were lost. Not profiting by the experience of that fire, the same office subsequently had another fire; the safe was left open as it had been before, but a citizen was able to push the doors to, from the window. Thus the records were preserved. This may have been considered clever, and the blame which should have been heaped upon the shoulders of the town clerk may not have been forthcoming, because the records were saved. It is hard to imagine the carelessness which prevails

in such matters, and if it were exhibited in a private business the official responsible would be immediately discharged.

Some of the worst conditions which now exist with reference to the care of public records are to be found in a number of our largest cities. An examination will show that in such cities as Rochester, Buffalo, Syracuse, and others too numerous to mention, the records are in serious danger because of the presence in the record rooms of large quantities of combustible wooden trim or wooden furniture. Some day a fire will take place, and then the community will seek to find the responsible parties; but if these investigations follow the usual history, no one will be held responsible and the community will have to bear the expense of reproducing the records. Thousands of dollars will be spent in this fashion, and the community will drift back into its old ways again.

Another item of danger in the care of city record offices is that of congestion of records. At the present time the law is inadequate to take care of the disposition of records which have ceased to have any legal or historical value. These accumulate, and as there is no distinction made between such and those that have value, the valueless and the valuable are frequently treated with shameful neglect. Were the law more adequate in the matter of making it possible for the clerks to dispose of records which are valueless from the point of view of the legal requirements and history, those which remain could be given more careful treatment.

The criminal carelessness exhibited by local officials in the care of their local records should not be permitted, and the central authorities should be placed in the position of being able to force the recalcitrant officials to protect themselves against themselves. Until that is done, not only are valuable records going to be destroyed by fire, but they are going to be subject to theft.

Every now and then in the catalogs of second-hand dealers we come across valuable papers which have evidently been abstracted from local record offices and are placed on sale at prices which are fairly astounding. Sometimes these records have a value because of the autographs of certain prominent individuals, and also because of their historic value. There is scarcely one record office in this State, except in the cases of those which have been most recently created, where the records are complete. Fire has destroyed some, but rank carelessness has permitted the disappearance or the theft of others. It is a rare thing to find that the offenders are ever brought to trial or punishment.

We could, if space permitted, enumerate specific instances of loss of records from all three of these dangers. It is sufficient, however, to call to the public attention the general conditions which exist, with the hope that a sentiment will be created which will uphold the hands of the central authorities in trying to inaugurate better systems for protection against destruction by fire, theft and carelessness due to congestion.

The Portable Motion Picture Projector; Its Present Status and Needs *

By Alexander F. Victor

Those of you who ventured into the new and untried, in the days when the motion picture was an undeveloped possibility, may recall that the first projectors were readily and easily portable. At that early stage of the industry, motion picture projectors were made as attachments to such types of optical lanterns as were then in use.

Film reels were rarely over fifty feet in length; and the usual method of manipulating was to run them through into a box, to be re-wound after the entertainment.

A later innovation was to run them in an endless fashion over a series of spools, lengthening the projection until the audience tired of the film episode.

Never-to-be-forgotten classics were "The May Irwin Kiss" and "The Watermelon Contest." "The Baths of Milano," a Lumiere product, added a full measure of enjoyment to many an evening's entertainment.

I do not know who first realized and expressed the magic possibilities of visualized story-telling. The first reaching-out in this direction that I personally saw was the "Spanish Bull Fight." This subject was taken and shown by the Electragraph, a projector employing a film somewhat larger than at present used.

The next was the Corbett-Fitzsimmons fight at Carson City. I do not recall the exact footage of these films; but at that time they seemed very impressive.

A little later an eager explorer reached out and placed a new milestone in the land of the motion picture industry, in the shape of a film dramatic production. Heretofore the "movie" had been a novelty without a permanent field and following. With the advent of the story, the motion picture became an essential part of the people's entertainment.

With the evolution from the short-story to the novelette, and thence to the complete novel, the film length increased amazingly.

The small apparatus of twenty-five years ago naturally proved inadequate to properly handle and project film reels measuring ten inches and more in diameter. The many mechanical requirements necessary to a creditable performance all conspired to make the portable projector an impossibility. The arc lamp and its housing, the take-up mechanism, and the resistance element added weight and subtracted portability.

*Paper read at Rochester meeting Society of Motion Picture Engineers.

In spite of these handicaps, the inventor has consistently striven to keep pace with the ever-increasing demands upon his ingenuity.

At this moment it would seem that the limit in film length had been attained. The film width and reel length have been established by this Society.

Aided by the very able lamp engineers—who have produced a wonderfully efficient type of incandescent lamp—the designers of portable projectors have been enabled to produce a machine which successfully handles film reels of one thousand foot length. A projector which delivers a satisfactory ten or twelve-foot image of standard illumination is extremely compact, easily transported and weighs twenty-five pounds or less.

Motion pictures whenever and wherever you want them are an accomplished fact. Wherever the ordinary illuminating voltage is obtainable, flickerless, brilliant motion pictures are possible.

The portable projector is the logical successor to the optical lantern. It does not enter into competition with its larger prototype, the professional projector; but in the home, in the classroom, in the church and in the equipment of many salesmen it fills an individual need in a most gratifying manner.

However, in spite of its more than worthy performance and its own most creditable record, the portable projector finds itself in a class of ethical outlaws, due to the company it keeps. No projector, no matter how conscientiously constructed, can take the "flam" out of inflammable film. The professional projector accomplishes the operation by means of the fire-resistive booth.

The portable projector becomes equally safe with the addition of the same booth, and accordingly loses its portability. No user could consistently arrive at the place of entertainment, carrying in one hand a truly portable projector weighing about twenty-five pounds, but, in the other hand, a fire-resistive booth weighing five hundred and fifty pounds.

Small wonder that a number of manufacturers, in their eagerness to meet the uncompromising public demand, are supplying portable projectors disguised as sample cases, lunch boxes and violin cases. What cannot be done with safety, according to official requirements, is always accomplished by stealth—with the same lack of safety.

Personally, I do not believe the portable projector to be unduly hazardous when used in offices or factories—even though inflammable film is used. *But,* when such machines are used, employing inflammable film without booth, in schools and churches—where the apparatus is frequently stationed in the center of a crowded room—then the risk is unwarrantable, unless the operator is skilled and cool-headed.

The amateur, with his indiscriminate use of the portable projector, is a menace to public safety and the good repute of the industry.

There is but one remedy for the present intolerable condition. So long as the market exists, portable projectors will be supplied. Since the uses for which portable projectors are intended preclude the use of booths, they will be used without.

Since the film employed is the fundamental fault, corrective measures must be applied in that direction. Hence the non-inflammable film.

This is not a new need; much has been said, but little has been done to alleviate conditions.

Except in one notable instance, manufacturers of portable projectors have listened to the siren song of the argument that only projectors using the standard films would be accepted—owing to the tremendous list of available subjects.

This impressive supply of film has been greatly over-valued. Out of the thousands of film subjects available, comparatively few are adaptable to the needs of the portable projector, whose users require principally educational and religious subjects.

I venture to estimate that the existing total of such films will not exceed five hundred, and these so scattered as to make it impossible to secure more than a small percentage of them.

The logical thing to do, it seems to me, is not to meet the obvious public demand, which results in an unhealthy condition, but to furnish the public with a product which meets its needs and creates a sound basis for the industry. Since standardization has produced a large library of inflammable film, why not create by the same means a library of non-inflammable film of suitable subjects and equal volume?

If all manufacturers of portable projectors were to combine and adopt a new standard for such machines, it would be but a short time before an enterprising industry would supply an adequate library of film. Since the number of existing film subjects suitable to portable projectors is so limited, it would seem quite practicable to arrange to have them reproduced on non-inflammable stock.

The most apparent obstacle to this plan is this: if a new standard is established by this Society and accepted by manufacturers of portable projectors, who is to make the film?

I would again ask those of you who were with the industry at its beginning to recall the period when there were but three sources from which to obtain film, although there were at least twenty-five different projectors clamoring for recognition.

I therefore feel justified in my belief that the adoption of a standardized non-inflammable film will be met with a supply of such film.

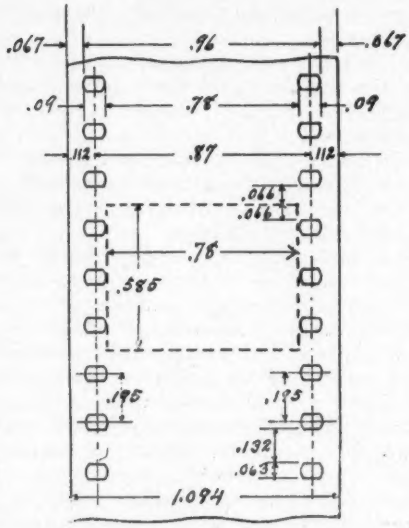
Create a demand, and invariably the supply comes to hand.

It may be necessary at first for the manufacturers of portable projectors themselves to make and supply a limited number of reels. Each one doing his bit, the impetus is given and the movement is well under way.

I believe the Underwriters' Code, as it is now drawn, to be very just. I do not believe that non-inflammable film of standard width and perforation (even though it carried a definite label) would sufficiently safeguard the public. Many unscrupulous exhibitors would use the wrong kind, and with everyone unconscious of danger the risk would be doubled.

There is, in my estimation, the greatest need for immediate action in this most undesirable state of affairs.

I respectfully submit a recommendation to this Society that the following three subjects be taken up for immediate discussion and acted upon:



Drawing to illustrate proposed film standard.

(1) That the present Underwriters' ruling regarding the use of non-inflammable film be approved by this Society.

(2) That a universal standard be adopted for approved non-inflammable film, so that manufacturers desiring to make and sell portable projectors may co-operate and turn out an interchangeable product.

(3) That the term "Portable Projector" and its definition be added to the Society's list of motion picture nomenclature.

I also submit the accompanying film standard as per drawing, which seems to me to fully meet all requirements. With a standardized non-inflammable film, universally adopted by all manufacturers, a film that will, if possible, permit printing by reduction from standard negatives, I see no reason why the portable projector may not come into its own.

It could thus enter its field of service unhampered by the stigma of criminal risk, safeguarding its users as conscientiously as does its big brother, the professional projector.

Testing of City Water Supply for Sprinklers.

By A. J. Meyer
(Member N. F. P. A.)

The proper method of testing the capacity of city water mains to determine their value as a source of supply to sprinklers has recently been under discussion by representatives of some of the stock insurance companies, and, unfortunately, widely different opinions are advanced. The growing use of single-source equipments fed by city mains makes the subject of great importance at this time.

Until quite recently there were two reasons for installing sprinkler equipments in plants: (1) protection against fire, and (2) reduction of insurance rate. The experience of inspectors in the field indicates that the second reason sometimes precedes the first. A new reason has developed in plants engaged in manufacture wherein production is of paramount importance, and proper fire prevention and protection measures are demanded by their customers. This usually leads to the question of sprinklers, and in many cases the cheapest equipment obtainable is desired, so long as it will be acceptable to the insurance interests to classify the risk as sprinklered. Plants located in towns having weak water supplies, or unfavorably located with respect to town or city water supplies, will take up with sprinkler companies or inspection bureaus the question of acceptance of available city water supplies. It then becomes necessary to make tests, and the only practical method is to use the nearest public hydrants.

The minimum requirement for acceptable primary supply from city mains in the middle western states is that, with a hydrant butt open and 500 gallons per minute flowing, underground pressure should indicate a pressure of at least 12 lbs. under the roof.

Two methods are advocated, and opinions are fairly well divided as follows:

(1) Gauge to be attached at hydrant nearest to plant and water discharged from the next hydrant on same main more remote from the source of supply.

(2) Gauge to be attached at hydrant nearest to plant and water discharged from opposite outlet of same hydrant; the flow of 500 gallons to be regulated by screwing a nozzle of suitable size to the outlet and opening the hydrant valve wide.

The first method is criticized (1) because the pressure indicated at the hydrant nearer the source of supply is higher than would be indicated at the base of the flowing hydrant (or rather in the main opposite this point), due to the "hydraulic gradient," or gradual increase of pressure toward the source; (2) service connections between the two hydrants might draw heavily enough to render the reading altogether

unreliable; (3) the proper correction for the difference in pressure due to length of pipe between hydrants cannot be determined with accuracy where pipes are small or have been long in service, hydrants are widely spaced and gridiron systems poorly balanced; (4) the inaccuracy liable in measuring the discharge of an open hydrant butt under low pressure with the Pitot tube and pressure gauge ordinarily used by inspectors in the field.

The second method has been criticised (1) because friction loss in the hydrant valve is not taken into consideration; (2) incrustations in the hydrant or pipe to the main might impede the flow so that pressure would be reduced; (3) eddy current in the hydrant barrel would affect the gauge; (4) that the plant owner and the sprinkler companies would not get a square deal.

In applying the latter method, we find that under ordinary conditions a 1½ to 2-inch nozzle is sufficient to give the required flow, and with hydrant valves of 4, 5, or 6-inch diameters wide open the friction loss would be small, undoubtedly less than the friction loss in a series of sprinkler piping with wet or dry-pipe valves, gate valves and fittings, etc., for which no allowance is made. This applies also to the question of eddy current.

The matter of incrustation in the hydrant barrel or the pipe to the main might cause an incorrect reading if the test terminated in a single trial. As a matter of fact, these tests are invariably conducted in the presence of an official of the waterworks or a representative of the plant owner, or both, and if the test proves disappointing to them or to the inspector, all of whom have some opinion as to the expected result, it leads to an immediate investigation. We who have made these tests know how a waterworks man "hits the ceiling" when an insurance inspector calmly informs him that his supply is inadequate, and if the results of the test do not come up to his expectations, he will remedy the trouble even if he has the dig up the hydrant.

The question of "square deal" needs no comment further than to say that the insurance companies who pass on the question of acceptance and who carry the fire risk are likewise entitled to some consideration in the matter. The proper method of testing is a square deal all around.

Much might perhaps be said about the theoretical accuracy of either of the above methods. Our aim is to devise a practical method to be applied in the field by a practical inspector armed only with a Pitot tube, a pressure gauge and a small book of tables. The second method is simpler and easier, as tests must be made in all seasons of weather; also it would permit of a more constant factor or application of a formula for correction if deemed necessary.

We all know that great accuracy cannot be attained in testing a doubtful water supply by a man alighting from a train (possibly while it is still in motion), going to a hydrant and making his test and taking the next train back. To be accurate, elaborate instruments would be required and tests would be made during a period of, say, three to six months; also the exact layout of the sprinkler equipment should be ascertained. Water pressures in public mains vary in the different seasons, even from day to day.

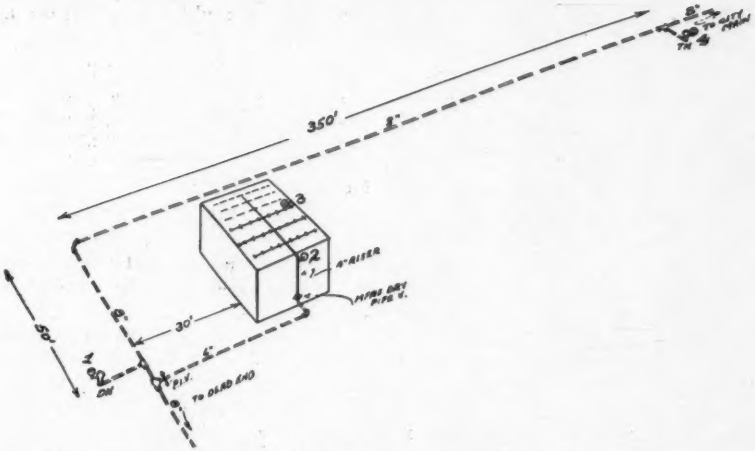


Diagram of property at which sprinkler water supply tests were made.

The testing of water supply to automatic sprinklers is different from the testing of the capacities of pumps or water systems under peak load conditions. Our result must be the automatic or normal condition. What we want to know is:—Is the supply ample under average conditions to give 12 lbs. pressure at the top of the sprinkler riser with 25 sprinklers or more playing on a fire? The power behind a hose stream is the pressure at the base of the play pipe, and the power behind the sprinklers is the pressure at the top of the riser.

Suppose, for example, we have a hydrant at the front of a plant, a gauge on one outlet and a 1¾-inch nozzle stream flowing on the other; top of riser 42 feet above nozzle, a static head of 18 lbs.; gauge showing 30 lbs., a discharge of 500 gallons. Now if we extend the hydrant up to the level of the top of the riser, we would have, for the same discharge, 12 lbs. on the hydrant gauge, and if we connected our sprinkler lines to the hydrant we would have the required supply.

In order to test this theory, the writer conducted tests as follows (see attached diagram):

Unused boiler house was used, 20 feet high; sprinkler lines 18 feet above grade level. Building was sprinklered in 1900 and contained six lines of sprinklers, staggered spaced, 1896 pipe schedule, eight and nine heads on alternate lines, or 51 heads in all, on 4-inch riser. Dry valve, outside control. Equipment is two-source, but tank was shut off during tests. Sprinklers and hydrants supplied by an 8-inch yard main supplied by a 12-inch street main, as shown on sketch.

Test No. 1.

Sprinklers were removed from three lines nearest riser, 25 heads, and replaced with fused heads. Static pressure at hydrants was ascer-

tained, then post indicator valve was opened and readings were as follows:

Static pressure at hydrants	43 lbs.
Gauge No. 1 (nearest hydrant)	35 lbs.
Gauge No. 2 (top of riser)	16 lbs.
Gauge No. 3 (farthest sprinkler)	2 lbs.
Gauge No. 4 (hydrant nearest to city main)	41 lbs.

Test No. 2.

Sprinklers were replaced and various pipes were disconnected until by opening the post indicator valve wide the gauges read the same as when the sprinklers were operating. It was found that with two 1½-inch pipes flowing full the gauges showed the same. A Pitot tube was then used to ascertain the discharge, showing pressures of 10 and 12 lbs., a discharge of 442 gallons.

Test No. 3.

Various smooth bore nozzles were attached on hydrant outlet opposite gauge No. 1, and it was found that a 1¾-inch nozzle flowing full and with hydrant valve wide open showed 23 lbs. pressure on gauge No. 1 and on Pitot tube held in the stream, a discharge of 436 gallons. Gauge No. 4 during this test showed 37 lbs.

The relation between the readings at Gauges Nos. 1 and 4 and the reading at the top of the riser indicates that the more correct reading is found on the gauge attached to the same hydrant as the water flow, the variation of pressure due to static head in this case being 7½ lbs. While the exact condition specified in the first method of testing could not be obtained, inasmuch as a hydrant more remote from the source of supply than the hydrant at the plant was impossible, this condition is not infrequently met in the field so that it would be used accordingly. All tests were made with valves wide open, discharges being regulated by size of pipes and nozzles, without the use of partly closed valves to cause friction loss or eddy currents

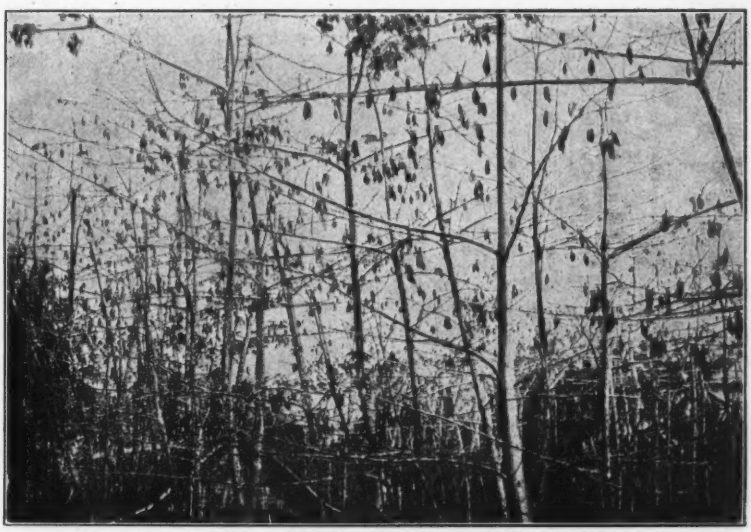


Fig. 1. Kapok trees with ripe Kapok.

Kapok and Its Hazards.

By Charles E. Worthington
(Member N. F. P. A.)

The increasing importation and use of "kapok," known also as silk floss, tree cotton and silk cotton, have aroused considerable apprehension as to its fire hazard both intrinsically and in comparison with other fibres.

Under its native Javanese name of kapok the fibre has been extensively used and greatly valued from remote times in tropical countries. It was first brought to European attention commercially during the latter half of the last century (1850 and later) chiefly through the efforts of the Dutch Government. That Government early adopted it as a standard material for stuffing army mattresses, cushions and life preservers, which action was soon followed by similar action of the German Government. Aside from these countries, but little in the way of consumption of kapok is recorded in Northern Europe, it having for some unknown reason failed to receive popular approval.

In the United States its principal use has been for mattress making, for which purpose it possesses some very favorable characteristics, such as lightness and great elasticity. It is also slow to absorb moisture and odors, and shows little tendency to pack and harden.

Experiments were made at an early stage in its use for stuffing life preservers, but with such indifferent success that its use for that purpose was temporarily forbidden. This prohibition has been since removed and the use of kapok is now specifically required.

Character of Fibre.

Kapok is the fibre surrounding the seeds in certain trees of the *Bombax* group found throughout most tropical countries. The trees are of considerable size. The seed pod in arrangement of seeds and fibre and in general appearance bears a strikingly close resemblance to the pod of the common milkweed (*asclepias cornuti*) found growing freely in the United States and Canada. The pods when ripe are gathered and broken open by hand and the seeds separated usually either by threshing above a latticed floor or by ginning machinery.

The fibre is then air dried on an open floor under shelter, and compressed for shipment by hand or power presses in burlap covered bales. The bale generally in use for transatlantic shipment is the "double" bale of about 16 cubic feet and weighing approximately 200 lbs. The fibre is highly compressed for shipment.

The fibre itself under the miscroscope is a simple cylinder (most fibres are compound), with a large continuous cavity except for occasional closure at one end. The outer walls are hard and smooth, having neither hooks nor corrugations, and do not adhere to each other so as to "felt" or mat; in fact, they appear under some conditions to repel each other to some extent. Kapok possesses an unusual and permanent lustre.

As might be inferred, there are numerous varieties (the *Bombax* group includes over 50 species), which differ considerably among themselves in many respects and qualities, but many kinds of the fibre so closely resemble each other in general appearance as to be distinguishable only by trained experts.

Most of this material imported into the United States comes from Java, the Philippines, Cochin China, British India and Africa. The Java and Philippine product is obtained from the tree *Ceiba Pentandra L.* (*Ceiba*—Canoe, from the use of the wood by the natives in canoe building; *Pentandra*—five-leaved), which is found mainly in Java, the adjacent islands, and the Philippines, the other varieties from several species of *Bombax,* chiefly *Bombax Malabaricum. C. pentandra,* however, has been found growing in tropical America and Florida, and the fibre was known to the early Spanish settlers as "Ceiba."

Java and Philippine kapok is very light. It is said to be capable of sustaining twenty to thirty times its own weight in water, while cork sustains but six times. Comparative weights of this and all other varieties are not at present obtainable in authentic form, but a comparison with some other fibres (animal and vegetable) published by the Dutch Government may be averaged and quoted as follows to show the number of pounds required to fill a given space when stuffed in, as in a mattress:

India kapok ..... 27.1 lbs.
Java kapok ..... 18.7 lbs.

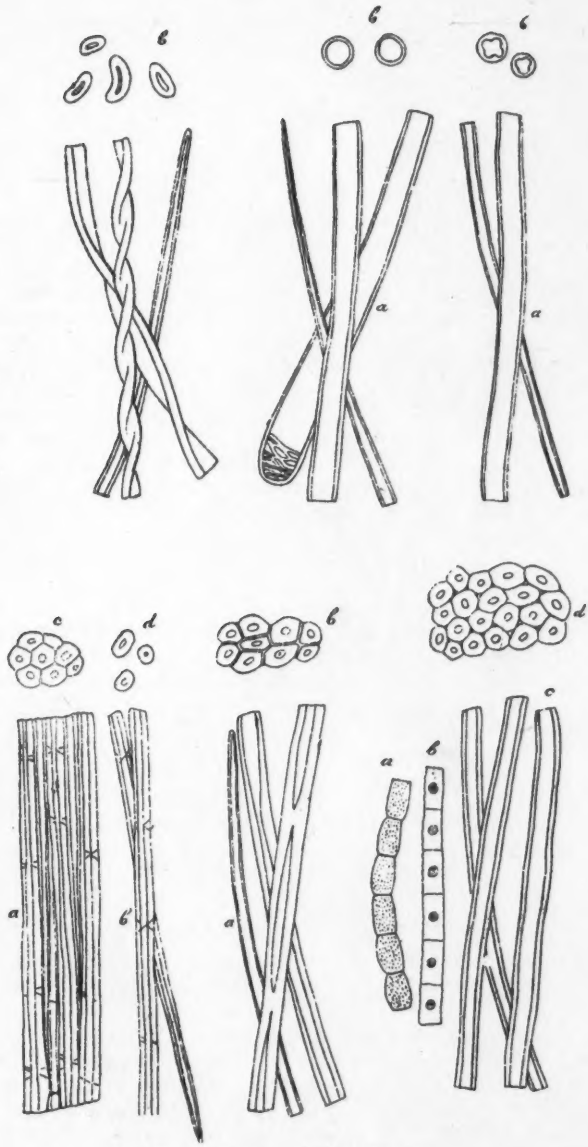


Fig. 2. Kapok and Other Fibres.

Cotton Kapok Plantain
Flax Jute Manila Hemp

Horsehair	27.5 lbs.
Seaweed	34.1 lbs.
Excelsior	35.5 lbs.
"African fibre"	27.5 lbs.
Straw	55.3 lbs.

Uses.

The principal use is in stuffing mattresses, cushions and life preservers.

The original experiment of stuffing life preservers in the United States is said to have been with kapok from British India. The first great test came at the loss of the *General Slocum* in East River, New York, when the preservers proved inadequate, and the use of kapok for that purpose was for the time discontinued and, as already stated, forbidden. Subsequent experiments, however, resulted in a complete reversal of the unfavorable verdict, and the Government now *requires* all life preservers to be stuffed with Java or Philippine kapok.

The fibre, which is shorter than cotton and of less strength, has been woven into cloth in Germany by the Chemnitzer Actien-Spinnerei after what is said to be a somewhat complicated preparation formulated by Goldberg, both alone and in combination with cotton and other fibres. It appears to take dyes well and retains its lustre, the yarns and plushes especially being soft and very handsome, resembling artificial (cellulose) silk. A Philadelphia firm has also been able to utilize the fibre in weaving draperies.

The cleaned seeds are used in making oil, which is said to be largely used as an adulterant in Oriental peanut oil, soap making, cooking oil, etc. The cake is fed to cattle and, it is said, occasionally roasted and eaten by the natives. The fibre from the bark is twisted into rope, the wood used for canoes and in tanning, and a red gum which exudes from the growing tree is said to possess medicinal qualities, as also are the crushed leaves and roots.

Analysis.

Analyses show about the usual percentage of ash, mineral and water and about 3 per cent. of wax, this latter content probably varying greatly. Nothing in the available data suggests any unusual inherent combustibility.

Special Characteristics.

As before stated, the walls of the fibre are perfectly smooth and cylindrical, thus preventing it from felting or matting, *i.e.*, permanently compacting. There seems also to be a disposition (probably electrical) of the fibres to become somewhat repellent when exposed to sunlight, so that a quantity which has been considerably compressed speedily regains its bulk and lightness when so exposed.

Kapok cloth when rubbed lightly develops about the same degree of frictional electricity as hard rubber, readily attracting small pieces of paper, etc.

The fibre absorbs moisture very slowly and only to a limited degree. The absorptive qualities of Indian kapok are said to be much

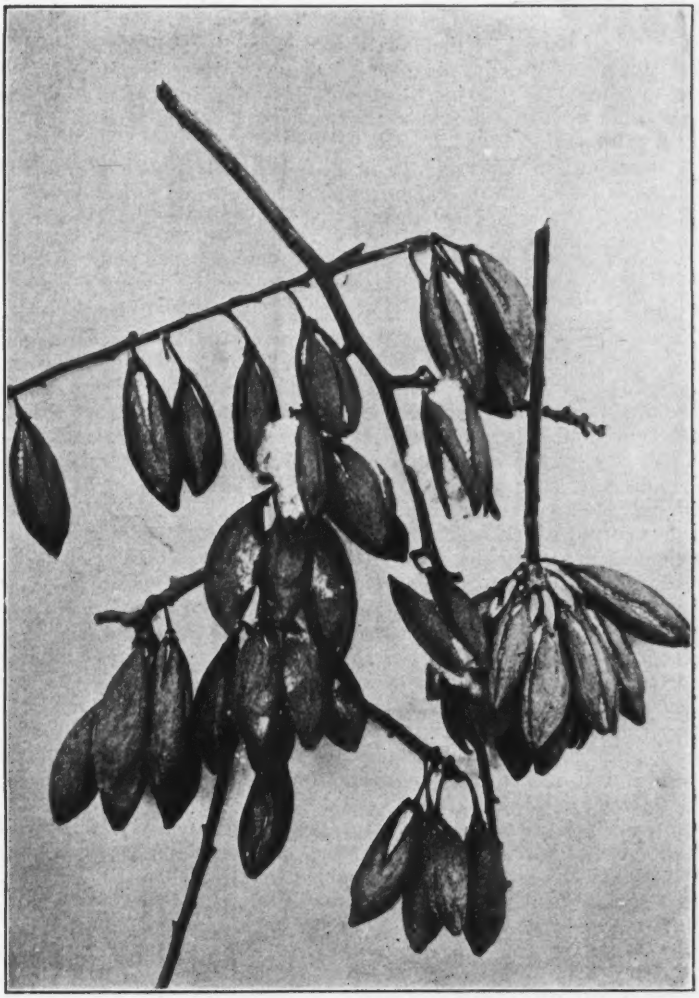


Fig. 3. Ripe Fruits of the Kapok Tree.

greater than those of the Java and Philippine varieties. It dries rapidly after wetting, without losing its elasticity. Like all other fibres of its class, it is a non-conductor of heat. It is also said to retain no odors and to afford a minimum harborage for vermin—both sanitary qualities of value.

Imports.

Most, if not all, of the Java kapok comes through Amsterdam. No very recent statistics are obtainable, but the total export of the Java product to the Netherlands increased from 1000 tons in 1889 to 7750 tons in 1909, while that of India kapok increased from 1250 tons to 8500 tons in the same period.

Re-export to America was in 1903 less than 100 tons of the Java product, a maximum of 400 tons being reached in 1907, followed by a decline to 200 tons in 1909. Since that date the American consumption has greatly increased.

Fire Hazard.

In mass kapok is very combustible and ignitable by ordinary sparks. When a pile is ignited the fire spreads very rapidly in the loose superficial fibre—quite as rapidly as in cotton linters, and apparently nearly as rapidly as in tow. Flame practically ceases when the surface fibres are burned away, and rapid burrowing incandescent combustion follows with considerable heat and moderate emission of pungent smoke.

In passing through pickers frictional electricity appears at times to be induced to such an extent that if the material is brought into close proximity to a conductor arcing and ignition follow. A number of fires have occurred which can be explained only on this hypothesis. A safer method than passing the material through pickers would seem to be its separation in slow-moving openers followed by blowing apart. If conveyors, fan cases and compacting bins are all of metal, the mass of metal will probably be adequate to absorb and radiate any electricity generated, and in any case the friction applied to the material is less. It would seem advisable, however, to adequately ground all pickers and electrically to connect all disconnected parts. In mattress-making the safer method appears to be to blow the material directly into the cases. Hand-stuffing involves the presence of much exposed loose material on floors and furnishes the conditions for rapid spread of any fire that may occur.

It is almost needless to say that the material should be handled and worked only under automatic sprinkler protection. The looseness and permeability of the piles and the non-absorptive character of the material should render fires in it unusually amenable to control and extinguishment by water thrown from sprinklers.

Comparative Hazard.

It is difficult to compare different substances, and kapok has both good and bad qualities.

It is apparently not readily subject to spontaneous ignition. Laboratory experiments so indicate and the experience of large importers extending over fifteen years supplies no instance of spontaneous ignition on shipboard or in storage. It is not absorptive and does not increase in bulk like the woody fibres (excelsior, jute, plantain), nor gain so enormously in weight when wet as do these and cotton and wool waste. The general permeability of the mass is an advantage in fighting any

fire that may occur in kapok, as water should reach the seat of combustion with little intermediate loss of bulk.

On the other hand, there is extreme inflammability and apparently electrical hazard. So long as the stock is in bales or handled under cover it would seem to present less hazard (except for possible semi-explosibility of air-blown stock while in pipes) than some of the other highly combustible fibres, but where loose stock is exposed the hazard is seemingly greater. In other words, the proximate hazard (of accidental ignition) is on the whole slightly less than that of several other fibres mentioned, and the ultimate hazard (capacity of supporting fire) about the same, but involving less possibility of collapsing floors due to increased weight than is the case with some materials. The principal danger arises from the ease with which superficial ignition is produced in loose stock.

From a fire prevention point of view three general precautions should be observed in use, viz.: reduction to a minimum of the volume of open or loose stock in the workroom, frequent sweeping to prevent accumulations, and prohibition of breaking or opening the bales in the same room with baled stock, the object of this last being to keep the quantity of kapok subject to ignition by fire in loose stock as small as possible.

Sulphur Colors.

By W. D. Milne, N. Richardson, and F. T. Gilbert
(Members N. F. P. A.)

The following is a somewhat tentative statement of such incomplete information as the writers have thus far been able to gather concerning the fire hazards connected with the materials used in the preparation of dyes of the "sulphur color" group. While much has been written concerning the purely chemical problems involved, little can be translated by the lay reader into a measure of the fire hazard.

General Description.

The "sulphur" or "sulphide" colors form one group of dyes out of several now being made in this country. The great demand recently for "khaki" has brought this group into special prominence.

Such colors are used without a mordant upon cotton goods quite extensively, but thus far have not been successfully applied commercially to woolen goods, owing to a difference between the chemical behavior of wool and that of cotton.

The sulphide colors, in general, are not soluble in the common organic solvents, but are soluble in sodium sulphide (Na_2S) or sodium polysulphide. These solvents have a reducing action on the dyestuff, and the resulting base combines with the cotton fibre on which it is oxidized and again converted to the dye. This point is of importance since it is such oxidizing action which is the fundamental cause of spontaneous ignition.

The general method employed for producing sulphide dyes is the fusing of a parent substance with sulphur mixed with sodium sulphide, or with sodium polysulphide. The parent substances include many complex organic compounds, many of which are nitro compounds, and concerning the fire or explosion hazards of which there is little well-defined or collected information.

Hazards.

The nitro compounds furnish a distinct explosion hazard which renders the fusing of them with sulphur alone unsafe. According to the degree of nitration these nitro compounds may in themselves be either inflammable or explosive, and attention should be given to the conditions of storage and use of these substances. It would be impossible for the layman to follow all the involved chemical operations carried out, as the variations are without number. Exact information as to the materials and processes used in the production of certain shades or colors is frequently refused by manufacturers as being secret, and

is perhaps not wholly essential to the investigator, since the special hazard is being constantly varied as new combinations are tried or experiments are carried out.

Many of the organic compounds used are not in themselves hazardous, though nearly all, when in a dry condition, will burn or fuse, leaving a crust-like residue. Among the more inflammable are nitrobenzol, nitrotoluol, and nitrophenol. The nitro compounds used have a lower degree of nitration and consequently present much less hazard than trinitrotoluol and trinitrophenol, which will be recognized as the high explosives "T. N. T." and picric acid respectively. Nitrosophenol appears to be liable to spontaneous ignition, especially when freshly made or impure. In the manufacture of the mono- and di-nitro products, carelessness or irregularity may cause formation of higher and highly explosive nitration products, a feature which adds to the hazard or to the uncertainty of the hazard in the dye plants in which the products are used.

It must be remembered that most organic substances, when mixed with substances which liberate oxygen readily, such as sodium nitrate, nitrites or chlorates, make highly inflammable and sometimes explosive mixtures, and that consequently great care must be used to secure proper segregation of storage of such materials.

Of the inorganic substances employed there are several involving pronounced hazard. Carbon bisulphide, which is sometimes used, has severe but fairly well understood hazards of inflammability and volatility. Sodium sulphide is somewhat susceptible to spontaneous ignition. The hazards of alcohol and the mineral acids are well known.

There is some evidence concerning the sulphur colors themselves which places them under suspicion of being liable to spontaneous ignition. Such ignition may perhaps be attributed to the tendency of the sodium sulphide, used as the solvent, to so ignite when an excess of this material is newly crystallized after the manufacture of the dye. The drying of the colors in steam-heated dry closets would tend to promote ignition, and fires in such places have been known. Fires have also occurred in print works, where goods printed with sulphide colors have ignited in ageing boxes. In such cases, however, corn oil or turkey red oil, used to promote oxidation of the color on the goods, may have been responsible.

In the manufacture of the dye preparations from the "intermediates" or parent substances there are two principal special hazards:

(1) **Fusing Kettles:** These may have direct fire heat, or heat by circulation of oil at high temperature. Whichever arrangement is used precautions for safety are necessary. Kettles should be in structures of fire-resistive or non-combustible material and should be isolated or cut off from storage areas.

(2) **Storage:** Among the variety of chemicals used are a number which, under certain conditions of storage, or in combination with other chemicals, are likely to give rise to fire. Storehouses for such material should be well built, dry and clean. Areas should be minimized by cut-offs. Materials of each sort should be segregated from all others, and any of dangerous character should be stored in locations properly

cut off from the remainder of the plant. There should be special areas for storage of acids. Materials subject to spontaneous ignition should be kept only in metal containers. Above all, the arrangement of storage should be under the constant supervision of a chemist cognizant of the hazards.

Notes on the Present Condition of the Industry.

Apart from the question of chemical hazards involved, there are certain conditions at present surrounding the dye manufacturing industry which are interesting from the fire protection standpoint. The dye industry in this country is hardly, if yet, out of the experimental stage, and in the nature of the business constant experimentation is necessary.

Under the urge of necessity, old manufacturing buildings have been used to house dye-making processes, or flimsy, hastily erected structures have been provided, neither well adapted to their use nor meeting the requirements of the best practice in fire protection. The high prices of dyestuffs have tempted concerns to undertake manufacturing with small capital. Such concerns have been unable to make expenditures for effective fire protection. They have lately been forced to meet competition by a few powerful interests possessed of larger resources both financially and along the line of technical knowledge.

Owing to the rapid change of popular taste or fashion in colors, experimental work must be constantly carried on. The frequent changes in processes and materials, necessary to produce new colors, not only alter and increase the fire hazards, but put small manufacturers at a great disadvantage financially as compared with the larger ones.

To achieve the highest success in the business, it is necessary for a dye manufacturer to be able to produce a full line of dyes for his customers, a condition necessitating a rather large and diversified plant.

Owing to the popular objection to the presence of a chemical plant in proximity to private residential property, such plants are frequently found in outlying districts where public fire protection is either absent or poor.

The dye industry is comparatively so new to this country that the methods of fire protection best suited to its conditions have not become generally known or utilized by those engaged in it. The special hazards of fire are apparently not clearly understood, and indeed seem so complex that actual experience with fires is necessary in order to establish the rules for safe operation. It also appears that a good tradition of painstaking care of housekeeping is far from being established.

Materials Used.

The following is a list of some of the materials used in making sulphur colors, with partial and preliminary notes on hazards connected with them:

Organic Substances.

Phenol.

Non-hazardous in itself. Better known as "carbolic acid."

Nitrophenol (ortho– and para–).
Non-hazardous in itself. Should be stored safely away from nitric acid and oxygen providers.

Dinitrophenol.
Not explosive alone when pure. Slightly more hazardous than the preceding on account of higher nitration. The same rules apply.

Nitrosophenol.
Burns readily when dry, with a smoky flame. Apparently somewhat subject to spontaneous combustion when impure and freshly made. Is explosive when fused with ammonium salts.

Para amido phenol.
Data not available.

Ortho amido phenol.
Data not available.

Chlorodinitrophenol.
Probably explosive in mixtures with other explosives, and dangerous with nitric acid or other nitrated material.

Dinitrobenzol.
Gives off poisonous fumes which attack the skin. Is used in explosive mixtures (10 per cent. in Faversham powder). The next higher nitration product, trinitrobenzol, is a high explosive suitable for shells. Product appears therefore to be hazardous in contact with nitric acid.

Dinitrochlorbenzol.
Is used in explosive mixtures (Roburite contains 14 per cent.; Amvis explosive contains 5 per cent.). Inflammable. Hazardous with benzol, nitric acid or nitration products. Liquid at ordinary temperatures.

Paranitroaniline.
Probably light hazard.

Nitrosodimethylaniline.
Data not available.

Nitronaphthalene (mono-)
Apparently quite inflammable. Higher nitration products are explosive or may be used in explosive mixtures.

Dinitronaphthalene.
Inflammable. Used in explosive mixtures with ammonium nitrate. Dangerous with nitrates, chlorates, etc., or with other nitration products.

Phenylenediamine (C_6H_4 $(NH_2)_2$).
Data not available.

Diphenylamine.
Data not available. (Is also used as a stabilizer for nitro high explosives and as an indicator of deterioration in them. May be nitrated to form a high explosive.)

Toluidine.
Data not available.

Metatoluylenediamine.
Data not available.

Dinitrotoluol.
Inflammable. Used widely in blasting mixtures. Hazardous if nitration is irregular. Dangerous with nitro groups, nitrates, acids.

Benzidine.
Data not available. (Its manufacture is very hazardous. See Von Schwartz' "Fire and Explosion Risks," p. 50.)

Paranitroacetanilid.
Inflammable. Explosive with nitro groups, etc.

Sulphanilic acid.
Data not available.

Xylidine.
Data not available.

Glucose.
Non-hazardous under ordinary conditions.

Many of the foregoing materials are handled in a moist condition, their inflammability being thereby much reduced.

Inorganic Substances.

Nitric acid.
Hazard is well known. Exceptional care should be taken in its handling in plants when organic compounds of the sort mentioned in the foregoing list are present, on account of the dangerous products it may form with them.

Sulphur.
Used in gunpowder. Dangerous with chlorates. Ignites spontaneously with lampblack, fresh charcoal, etc. Its suspended dust may ignite by static electricity discharge. Should be stored alone.

Sulphur chloride.
Non-hazardous liquid.

Carbon disulphide.
Inflammable volatile. Hazard severe and well known.

Glauber's salts (sodium sulphate).
Non-hazardous. A fire extinguishing agent.

Sodium Sulphide.
Ignites spontaneously sometimes when freshly made and with finely divided charcoal, etc. Dangerous therefore with organic nitrated material as in foregoing list.

Sodium bisulphite.
Light hazard.

Sodium nitrite.
Liberates oxygen when heated. Fusing process likely to give rise to explosion, especially with ammonium salts.

Salt.
No hazard.

Soda ash.
No hazard.

Lime.
Well-known hazard. Isolate and keep dry.

Muriatic acid.
Light hazard.

Books Consulted.

Artificial Dyestuffs, *Ramsey & Weston.*
Chemical Abstracts, *Various.*
Fire and Explosion Risks, *Von Schwartz.*
Organic Chemistry, *Remsen.*
Special Reports of Mutual Companies.
Underwriters' Bureau of New England Reports.
Encyclopædias.
Coal Tar Intermediate Plants, *William Vlachos.*

Partial Fire Record (New England).

(6094.) Nitrosophenol, freshly made, in open barrels, ignited spontaneously, and burned with a smoky flame. Fire promptly discovered. The substance was for use in "sulphur blues."

(3613.) Sodium Sulphide, freshly made and discharged from a steam-heated drum, was stored in a small bin. Fire started in or near the bin and did about $42,000 damage.

(2927.) Sulphur colors, etc. In storehouse were bags of sulphur, and a sulphur color made from dinitrotoluol, sulphur and sodium sulphide in barrels. Fire arose from apparently spontaneous causes, with heavy loss ensuing.

(315.) Sulphur colors. "Khaki" dye made from an organic compound and sulphur and sodium sulphide was being dried in a 40 x 7 wood steam-heated drier. Fire started in the drier. Cause supposed to have been spontaneous action of the chemicals, encouraged by the heat of the drier. Loss severe.

(B. T.) Sodium sulphide. Freight cars contained 111 wooden barrels of chipped sodium sulphide. Fire started spontaneously.

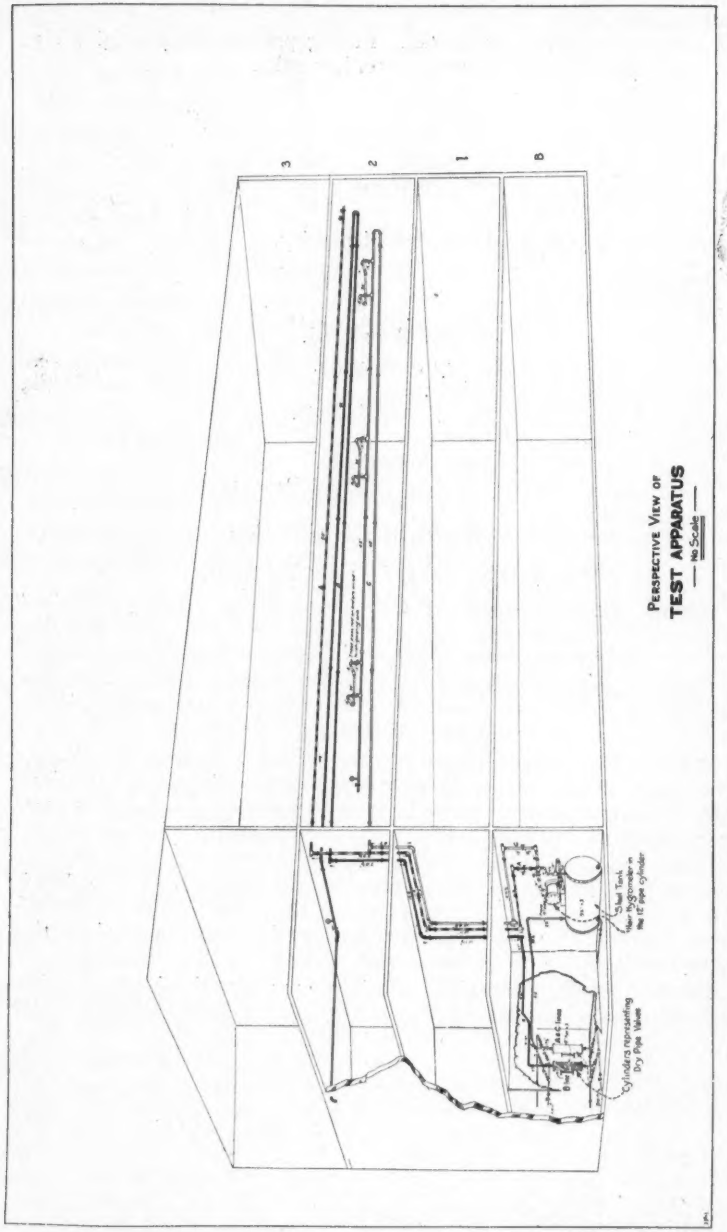


Fig. 1. Apparatus used in investigation of characteristics of ice formation in sprinkler piping in refrigeration rooms and other unheated buildings.

Dry-Pipe Sprinkler Systems in Refrigeration Rooms.

By C. L. Scofield,
Chairman, Committee on Automatic Sprinklers.

Herewith is given a resumé of the experimental tests and observations to November 15th, 1918, with the test apparatus referred to in the Committee report for 1917.

Historical.

The objects of the research being conducted are, first, to discover the characteristics of ice formation in sprinkler piping in refrigeration rooms and other unheated buildings, and secondly, to determine if the automatic protection is likely to be seriously impaired by such formation.

A difference of opinion exists regarding ice formation as reported in sprinkler piping of this type, some claiming that accidental flooding with water is the true cause, while others have pointed to a law of physics by which all moisture, either liquid or solid, will seek the places of lower vapor pressure from those of higher vapor pressure, and consequently ice could be formed in the sprinkler piping from the evaporation of the priming water of the dry-pipe valve and from the moisture contained in the air pumped into the system. A special test apparatus was designed so that it can be readily taken apart with a view to determining these features and hence avoiding the taking apart of a regular sprinkler system and the interruption of the automatic protection.

Through the courtesy of the William Davies Company, large Canadian packers, the apparatus has been installed in one of the cold storage buildings of their Montreal plant, and every facility has been afforded by the William Davies Company in the conduct of the tests. Acknowledgment is also made to Dr. H. T. Barnes and Professor H. E. Reilley of the Physics Department, McGill University, for assistance in the preparation of the apparatus and the conduct of the tests. Thanks are likewise due to the W. J. McGuire Company, sprinkler contractors, who donated the labor for the original setting up of the apparatus, and to Messrs. P. L. Wormeley of the Bureau of Standards, W. O. Teague of the Factory Mutual Laboratories, and C. R. Alling of the Underwriters' Laboratories for criticisms on the plans submitted. The Canadian Fire Underwriters' Association have defrayed all expenses for materials and other incidentals, and have given the services of their inspectors for the various details. Of the inspection staff, Mr. T. H. MacPeak has largely attended to the refitting of the apparatus, to the weekly pumping up of the system and changing of the hygrometer charts, assisted at times by Messrs. W. J. McCarthy, C. W. Ellsworth, C. F. Harris and G. A. Napier.

Description of Apparatus.

The apparatus is intended to approximate a sprinkler system, except for the omission of the sprinkler heads and in the use of only one size of piping 1¼ inches in diameter. The main piping is installed in a freezer on the second floor of a three-story and basement fire-resistive cold storage warehouse, and really consists of separate units, the essential details of which can be gathered from the accompanying illustration and photographs and the following description:

The two cylinders, composed of 8-inch pipe, in the left-hand corner (see illustration) represent dry-pipe valves and are located in the basement in a small cut-off room equipped with steam coils and containing the dry-pipe valves for the automatic sprinkler system with which the warehouse is equipped. The left-hand cylinder with the piping leading to the freezer room and then discharging outdoors is entirely separate from the other piping, and while the air and water supplies are shown as attached, they are not connected except temporarily from time to time. All outlets are plugged. The objects of this latter unit of the apparatus are (1) to determine if there is any evaporation of the priming water due to the great differences in temperature between the dry-pipe valve enclosure and the refrigeration room, and (2) if cold water will flow freely through the cold piping, the temperature of the city water in Montreal going as low as 35° F. in the winter. This pipe does not really discharge outdoors as illustrated, but to an inside drain.

The right-hand cylinder represents another dry-pipe valve, with discharge to a steel tank of 502 U. S. gallons capacity in the hallway outside of the dry-pipe valve enclosure. The only function of this tank is to provide the volume of air equal to that contained in an average dry-pipe sprinkler system. The discharge from the tank is through a cylinder of 12-inch pipe, containing a hair hygrometer, loaned by McGill University, to record the humidity of the air pumped into the system. The hygrometer can be "by-passed" if necessary.

From the hygrometer chamber the piping is divided into two branches, one portion extending the length of the refrigeration room near the ceiling, and the other practically twice the length of the first, with three by-passes of 1-inch pipe, which are wired to the refrigeration coils. These by-passes were provided at the suggestion of Dr. Barnes. If ice forms in the coldest part of the piping, by arranging by-passes in direct contact with the refrigeration coils the ice deposits will take place in the by-passes, leaving the sprinkler pipes free. No water has been put into any part of the system connected with this second cylinder, except that contained in the cylinder itself to represent the priming water. The city supply, as shown, is not normally connected up and the outlets are plugged. A careful record has been kept of the air pumped into the system after it was turned over by the sprinkler contractor, as described later on.

The hallways containing the steel tank and the piping are not heated, and the walls between the hallways and the refrigeration rooms are of patent cement and cork composition seven inches thick.

The piping in the refrigeration room is suspended from the iron

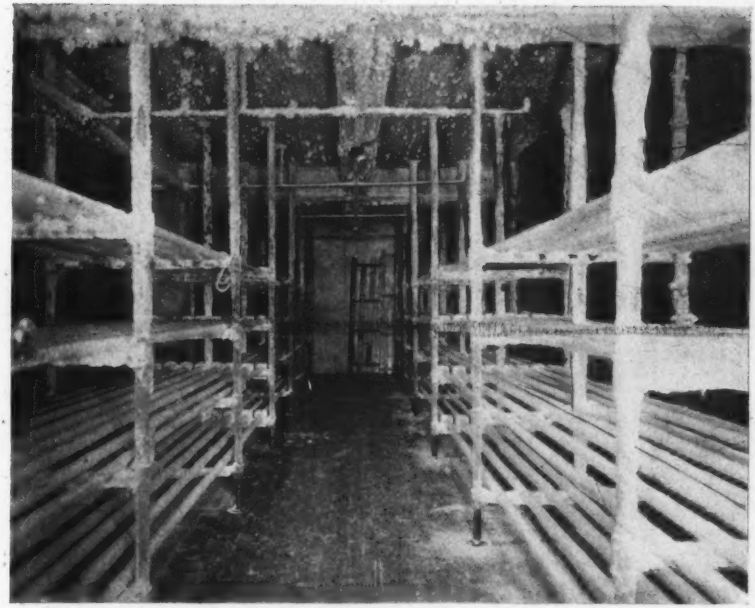


Fig 2. View of side of refrigeration room where piping of test apparatus is located. X shows type of uprights with cross arms to hold piping. Photograph was taken after test apparatus piping had been removed.

supports of the refrigeration coils shown in the photograph. The piping, excepting the by-passes mentioned above, is separated from the refrigeration coils about three inches and from the wall of the refrigeration room fourteen inches.

The capacity of the apparatus in U. S. gallons is as follows:

Tank	502.36
Piping, A and C lines, including cylinder	32.30
	534.66

Tests.

The steam air compressor, made by the Canadian Westinghouse, is located in the boiler room, and draws its supply of air from outdoors. The air supply pipe has a run of approximately 400 feet through rooms of various temperatures, a few of them coolers, and also a short run outdoors before it reaches the cold storage building in which the apparatus is located. There is a calcium chloride dryer on the line in the dry-pipe valve house for the main plant, but this is not in use.

The apparatus was practically completed in April, 1917, but after several trials showed that considerable "tuning up" would be needed to make it air-tight; war conditions so depleted the inspection staff of the

Canadian Fire Underwriters' Association it was not felt that the necessary time could be spared for nearly a year.

On March 2nd, 1918, a water flowing test of a little over five minutes' duration was made on "B" line in the presence of the writer and others of the inspection staff of the Canadian Fire Underwriters' Association. The temperature of the city water was 36° F.; the temperature of refrigeration room 11° F. The water ran freely and the piping was promptly drained, but subsequently considerable ice was found in the upper line due to improper drainage. On April 17th, 1918, all of this pipe was taken down, dried outdoors in the sun, and replaced the following day with a better pitch.

On April 16th, 1918, all of the air piping (A and C lines) in the refrigeration room was taken down and examined in the presence of Professor H. E. Reilley of McGill University, the writer and others of the inspection staff of the Canadian Fire Underwriters' Association. The following is quoted from the statement of Professor Reilley:

> "A considerable amount of frozen condensed vapour was found inside of this piping close to the wall of the freezer where pipes enter from hallway. The ring of frost deposit occupied about two-thirds of the total area of cross section of the pipe.
>
> "A small deposit was also found in one of the by-pass pipes in the refrigeration room. With these exceptions the system was free from obstructions."

No record had been kept by the sprinkler contractors of the volume of air pumped into the apparatus to test it out before being turned over. Such a record, however, was kept by the Canadian Fire Underwriters' Association in April and May, 1917, but not having complete data, no figures can be given. The air that was pumped in during these times was responsible for the ice found in April, 1918. Ice was also found in the 2-inch drain from the tank.

From May 7th to 23rd, 1918, the air lines ("A" and "C") and steel tank were carefully gone over for leaks, being pumped up almost daily, and a record of the air pressure kept. Flanges were substituted for the unions on the lower line of "C," the pipe being taken outside for the purpose. A small amount of snowy ice was found in this pipe near the wall of the freezer where the pipes enter from the hallway. Several sections of new pipe were substituted for those found defective.

On May 22nd, 1918, flanges were substituted for the unions on the "A" line. No ice was found except a small quantity near the wall at the hallway. On May 28th the drain connection at the steel tank was changed and fitted with a special connecting piece so that the tank could be entirely drained of any moisture. The actual test was started on May 23rd, for the pipes had been opened up as noted above and all the ice was cleaned out. The apparatus was then sufficiently tight to require pumping only once a week, which was the end sought.

From May 23rd to November 14th, 1918, a "log" has been kept of the pressure of the air pumped into the system and of the temperatures of the refrigeration room, the hall outside of same, the tank space and the valve room, although they are not entirely complete for the latter three. The readings were taken daily at 1, 4, 7 and 10 a.m. and 1, 4, 7 and 10 p.m. by the representatives of the William Davies Company when making their rounds of the freezers, and were copied weekly by

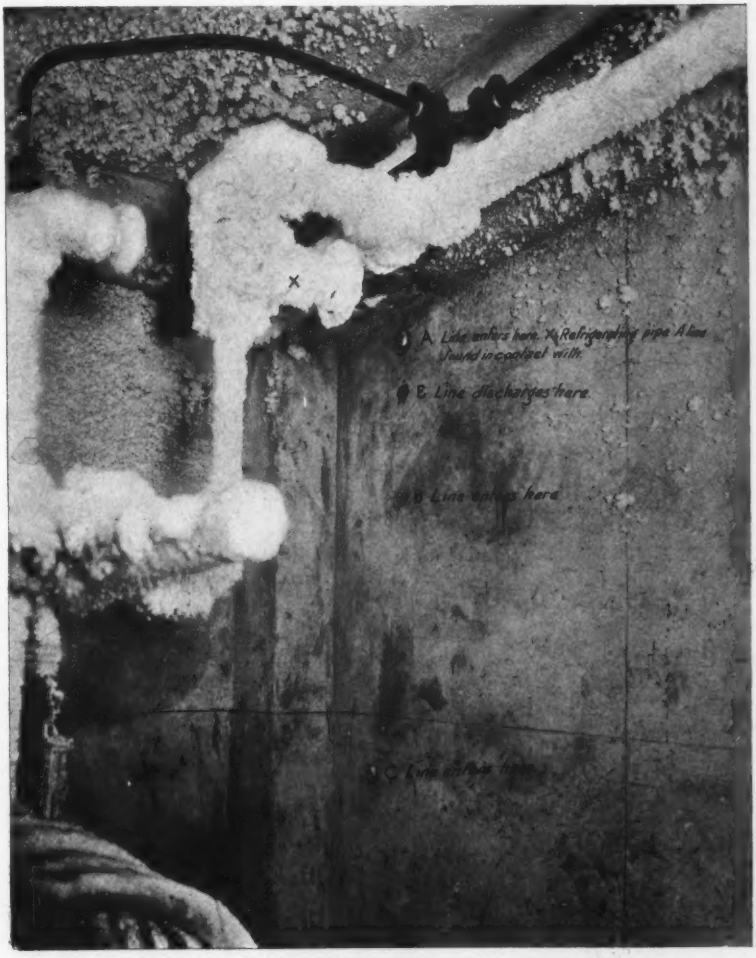


Fig. 3. Shows Corner of Refrigerating Room where pipes for test apparatus enter from hallway.

the inspectors of the Canadian Fire Underwriters' Association when changing the hygrometer charts and pumping the air into the system.

The weekly loss in air pressure ranged from 12 to 23 lbs., a maximum of 45 lbs. being re-established. The volume of air pumped into the system from May 23rd to November 14, 1918, is estimated at 764 cubic feet.

The temperatures in the refrigeration room have ranged from –20°

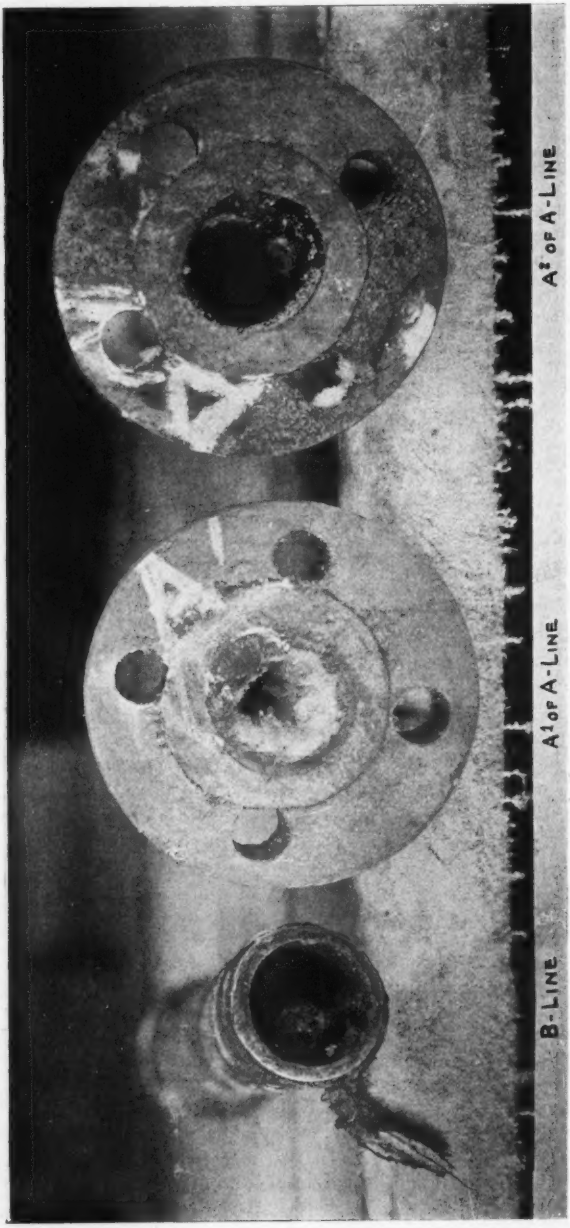


Fig. 4. Photograph of ice found in "A" and "B" lines of test apparatus.

F. to 27° F. Some of the changes have been quite rapid, as –8° F. to 25° F., and –14° F. to 19° F. each inside of twelve hours. The maximum temperature recorded is 27° F. for a short period. A fair average temperature would be zero to 12° F.

The temperatures of the valve room, tank space and hallway outside of the refrigeration room have ranged from 37° F. to 60° F.

On November 15th, the date on which the latest examination of the test apparatus was made, the temperature in the refrigeration room stood mostly at zero, maximum 7° above, minimum 5° below, while that of the hallway was 39° F.

The absence of the records on some dates of the temperatures aside from the refrigeration room is not considered important, as the test was run through the season when there was no artificial heat in the building. The next test will be carried through the winter when steam will be on the valve house and the temperatures of the tank space and hallways will be considerably lower, for, as previously stated, they are not heated, and the hallways will be more or less exposed to the extremes of temperature when outside doors are opened for moving stock.

The hygrometer charts have registered practically 100% humidity throughout. For very short periods the humidity has gone down to 95%.

Procedure.

The pipes inside the refrigeration room were all taken down and examined on November 15th, 1918, in the presence of Professor Reilley, the writer and others of the inspection staff of the Canadian Fire Underwriters' Association. The procedure was as follows:

The tank drain was opened and the tank found absolutely dry.

The nipples and caps on the low points of "A," "B" and "C" lines were removed. "A" and "B" lines were found dry; about a tablespoonful of water was removed from "C" line.

The caps were removed from the ends of "A," "B" and "C" lines in the hallway where the pipes enter the refrigeration room. The pipes were then disconnected in the refrigeration room, starting with "A" line. Ice was found as follows:

"A" line, the piece of pipe that extends through the wall projects 4 inches into the refrigeration room to a flange connecting it with the next piece of pipe. Directly inside of the room snowy ice had formed and the pipe was found completely blocked at the face of the flange (see A1 in photograph). The second piece of pipe, about 12 feet long, was found in contact with the refrigeration coil in the corner at the ceiling and about 9 inches from the flange. Snowy ice was found extending about 10 inches in the pipe from the face of the flange (see A2 in photograph). On melting the ice in pipe A1, the water measured .182 gills, and in pipe A2 measured 1.21 gills.

"C" line. A small amount of snowy ice was found in the pipe just inside the wall of the refrigeration room. The cap not having been replaced on the pipe in the hallway, the ice was melted by the warm air entering from the hallway through the open pipe on disconnecting the pipe inside the freezer. As noted above, a small amount of water was previously found at the base of "C" line in the lower hall at the tank.

"B" line. Ice was found in the lower section just inside the wall of the refrigeration room (see photograph). Its consistency was partly of the nature of black ice and partly snowy ice, as seen when the ice was removed by heating the pipe with the blow torch. This might be accounted for by the opening in the wall through which the pipe enters the refrigeration room not being absolutely tight, so that when the temperature of the room rose on being filled with fresh-killed stock the snowy ice had been softened, due to a small leakage of air from the hallway around the opening at the pipe. On the day of the test hoarfrost was found on all the piping at the points where it extended through the wall. As previously stated, no air has been pumped into "B" line, which was taken down and dried out in the sun after the water flowing test of March 2nd last. It is believed that any ice in this pipe must have been due to the evaporation of the priming water. When melted, the quantity of water in "B" line measured .80 gills. The water in the left-hand cylinder in the dry-pipe valve room connected with "B" line had lowered 8¼ inches since the apparatus was set up in May last, or an evaporation of approximately 2 gallons. There is here an apparent discrepancy. Two gallons of water have disappeared from the priming water while only a fraction of a gill has been accounted for as ice in the "B" line of piping. It is now necessary to discover, if possible, what became of the difference between those two quantities. Several causes may have contributed to this loss of priming water. This will be investigated at further length and an explanation advanced after our next test has been completed.

No ice was found in any of the other piping, which, as previously stated, was entirely taken down. The photograph of the refrigeration room was taken after the piping had been removed, except for the three pieces photographed, and shows the refrigeration coils, but not the pipe of the apparatus, which is supported on the small cross arms of the uprights holding the refrigeration coils.

Summary.

It is felt that the tests should be continued before making any deductions or any recommendations. It is believed, however, that several facts are already demonstrated, among them, that snowy ice will build up at the first point where there is a steep temperature gradient, especially below freezing, and second, that there can be ice formation from the evaporation of the priming water as well as from the moisture contained in the air pumped into a sprinkler system. It is also felt that all of the ice reported in sprinkler systems in refrigeration rooms within the last few years by several inspection departments was not necessarily due to accidental flooding of the systems with water and improper drainage.

This is not a report of the Committee on Automatic Sprinklers, the members not having had any opportunity to discuss the results of the tests, but is intended simply as a description of the apparatus, an account of the experiments being carried on and the conditions found by these observations. This statement has been prepared jointly with Professor H. E. Reilley of McGill University. Any criticisms or suggestions in the further conduct of the tests will be greatly appreciated.

Fire Hazard of the Newer "Drying" Oils.

(Soya, perilla, tung, fish or menhaden)

By G. B. Heckel,

Secretary, National Varnish Manufacturers' Association.

The shortage of vegetable and animal oils incident to the war prompted in this, as in other fields of industry, a general pooling of resources and a rapid readjustment of technique.

On the Atlantic seaboard all available ocean tonnage was commandeered for the movement of troops, equipment and supplies necessary to the maintenance of our Expeditionary Forces and for the provisioning of our Allies. This prompted a call upon the less heavily burdened cargo carrying capacity of the Pacific for substitute materials from the Far East.

Two oils from Asia had already assumed some importance in industry, and several others had been under investigation. Of these, tung or China wood oil had become a staple raw material in varnish manufacture as well as in some special branches of paint manufacture. A second, soya, soy, or soja bean oil had been found valuable in both these industries as well as in soap making, and in its native habitat was a valuable food material. Of the remainder, perilla oil was just gaining recognition as a drying oil almost identical in its properties with linseed oil.

The shortage of linseed oil and of oils and fats in general led to a very large importation of these Oriental oils, and their storage in bulk on an important scale at Pacific ports.

Fire protection engineers are naturally interested in knowing what fire hazard attaches to these commodities.

The entire matter may be summed up in a phrase: these oils are all, as to their status as "risks," on the same footing as linseed oil. They are all, to a greater or less degree, "drying oils,"—that is, unsaturated glycerides of fatty acids, capable of absorbing oxygen and becoming thereby converted into semi-solids.

Such oxidation under normal conditions is an exceedingly slow process and negligible. When, however, any of these drying oils is spread in a thin layer and subjected to oxidation in small space, insulated from radiation (as, for example, when spread on rags or waste tightly rolled) the temperature may rise to the ignition point (spontaneous combustion) exactly as in the familiar case of linseed oil.

The so-called "iodine number" of a drying oil is usually a fair index of this property, and from the following list of these values, taken from Lewkowitsch and other sources, it will be seen that none of these newer oils, excepting perilla, is more hazardous from this point of view than linseed oil:

	Iodine Value
Linseed oil	175—190
Perilla oil	189—202
Soya oil	124—143
Tung oil	159—176
Fish oil (Menhaden)	148—193

Summing up this item of hazard, it may be confidently stated that there is no risk attached to the storage or transportation of any of these oils in bulk or package. It should be remembered, however, that in the event of such oils in bulk being exposed to fire from without they are likely to provide dangerous fuel for a conflagration.

The remaining factors of hazard are the flash-point and the ignition point. As is well known, the "flash-point" is that temperature at which a body begins to distill inflammable gas or vapor; and the ignition point that temperature at which a body will ignite and continue to burn. In both respects all of the fixed vegetable oils are comparatively safe hazards, comparable in no respect to mineral and other volatile oils.

Data on these points are not readily accessible, since these constants are of no importance except to the varnish maker. The flash-point of linseed oil, however, is well over 500° Fahr., and its ignition-point considerably above 600° Fahr.—625° to 640°. These physical constants for the other oils under consideration lie within approximately the same ranges, excepting for tung oil, which, long before these temperatures are attained, polymerizes and solidifies into a tough mass resembling india rubber.

In conclusion, it may be safely assumed that conditions applicable to linseed oil may be safely extended to cover any of these less familiar "drying oils."

Since the above was written the following reports on the flash and ignition points of the several oils have been received, No. 1 being from Lieutenant H. A. Gardner, of the Institute of Industrial Research, and No. 2 from Dr. Henry Schwarcman, of Spencer, Kellogg & Sons:

No. 1	**Flash Point**	**Ignition Point**
China Wood Oil	554 F	Solidified before ignition point was reached
Soya Bean Oil	Above 608 F	Not determined
Menhaden Oil	450 F	523 F
Perilla Oil	522 F	581 F
No. 2		
Linseed Oil	574 F	652 F
China Wood Oil	552 F	628 F
Soya Bean Oil	585 F	674 F
Menhaden Oil	435 F	492 F

The particular point noticeable in these two reports is that they agree in giving soya bean oil both a higher flash point and a higher ignition point than any of the other oils. Mr. Gardner's investigation is much the later of the two.

Fig. 1. Neglect of peat bog fires such as this was an important factor in the Northern Minnesota Forest Conflagrations of 1918. The fire shown occurred a mile southwest of the town of Atkinson.

The Forest Conflagrations in Northern Minnesota.

The forest fires which in October, 1918, swept over parts of Northern Minnesota—wiping out whole towns, causing hundreds of deaths and the loss of millions of dollars' worth of property, and converting great tracts of country into desolate waste—take their place among the historic object lessons which, notwithstanding their severity, seem to have so little effect upon the apathy of the American people in matters of fire prevention and fire protection. Of course, the circumstances were unusual: great disasters are always attended by unusual circumstances. The point is that for some years the policy of the State legislature and the attitude of the people generally had tended to produce, rather than to hinder, the occurrence of the conditions that had such terrible results.

The Insurance Department of Minnesota is responsible for the statement that peat bog fires had been burning all summer, but that no particular apprehension had been felt on that account. The promiscuous burning of brush by settlers in contravention of orders of the State Safety Commission was another cause contributing to the final conflagrations—to which must be added the normal hazard of sparks from locomotives and agricultural engines. The appropriation for forest fire protection has been greatly reduced during the past four years, and the patrol

Fig. 2. The residence section of Cloquet after the fire.

Fig. 3. This was the business section of Cloquet.

service had consequently become altogether inadequate. Thus it was that no steps were taken to regulate the conditions under which certain districts were dangerously "over-drained" and bog fires rendered almost inevitable, and thus it was that no trenches were dug around the bog fires, when they occurred, to prevent their spread into the surrounding brush and timber.

Although some reports laid great stress upon the high wind as a cause of the catastrophe, it appears from a statement by the meteorologist in charge of the local bureau at Duluth that the conflagration itself was largely responsible for the windstorm, except for a few hours on the first day, when a stiff gale fanned the existing fires to perilous proportions. After that the fire produced its own draft—an up-draft and an in-draft—as such fires always do.

According to State Forester Cox, the destruction was not due to one immense fire sweeping from Bemidji to Duluth, but to a number of fires, the largest of which traveled about twenty miles. The fires burned in strips with constantly narrowing fronts, leaving great patches of green timber between them. The wildest fire—that which destroyed Moose Lake—had a front of approximately seven miles, the Cloquet fire had about a six-mile front, and so on.

Some idea of the havoc can be gained from the accompanying photographs. The thriving towns of Moose Lake and Cloquet were laid low and many smaller places were utterly destroyed. Duluth itself suffered

Fig. 4. Effect of fire on 12-inch concrete wall of single story garage.

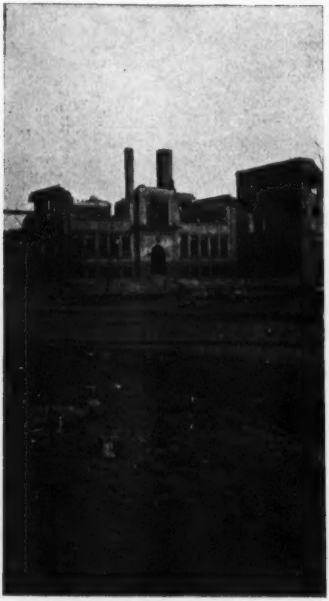


Fig. 5. Ruined High School Building, Cloquet.

heavy damage, and according to one of the local newspapers it was only good fortune which saved the city from an unparalleled disaster. Vacant lots covered with underbrush and trees were said to be very numerous even in many of the central portions, and if once the flames had gotten a hold upon the city proper, it would have been well-nigh impossible to keep them in check.

As usual, railwaymen displayed splendid heroism in rescuing the inhabitants of the burning districts, and large numbers of volunteers with automobiles also risked their lives again and again in attempting to bring fugitives into places of safety. For the indomitable energy and courage displayed in the emergency by practically all concerned it is impossible to feel anything but admiration, but the reflection cannot be avoided that steady practice of the more prosaic civic virtues would have been more fruitful. In the report of the special commission appointed by Governor Burnquist to investigate the causes of the disaster, it is definitely suggested that although the existing laws seem plain and sufficient, few of the people read the law or appreciate its obligations; that prosecutions for unlawfully setting or neglecting fires have been quite generally mere farces, the penalties being too small in the rare cases in which convictions have been obtained; that drainage enterprises on a large scale have been undertaken with less regard to the public interest

Fig. 6. The remains of a cooking stove.

Fig. 7. Brass bushings melted out of fire hydrant. Paint is still on hydrant and apparently no flame touched it.

than to the private interests of drainage contractors; and that the cities, towns and villages have frequently disobeyed the laws requiring them to create fire-breaks by clearing and plowing.

As an illustration of the extent to which the forest service had been depleted, the Commission mentions that the ranger of the district in which Moose Lake was situated had 160 townships under his care. He was assisted by two regular patrolmen! Difficulties have also been experienced in connection with the remuneration of citizens summoned by forest service officers to assist them in cases of emergency. Owing to the inadequacy of the available funds, it has been necessary for the state forester to exercise a wide discretion in granting or withholding payments recommended by the rangers, and this has inevitably led to complaints. The Commission points out that unless drastic measures are taken to clear the burned areas the menace caused by partially burned timber and debris left on the land and the combustible material that will grow on it is likely within a year or two to be greater than ever.

Among the interesting features of the great fire was the emergence of packs of timber wolves which, made bold by the disappearance of the marks of civilization, scoured the countryside in search of food, causing

additional losses of live stock and in some cases threatening refugees on the way to neighboring settlements. It is to be hoped that stringent legislative and administrative measures will be taken to prevent the wolves of lawless private interest specified by the special commission of investigation from again making their appearance in the devastated area and again imperilling the lives and homes of the people of Minnesota through their selfish disregard of the general welfare.

Freaks of the Fire.

The fire presented many freaks for notes and pictures of which we are indebted to member E. M. Hawes, of Chicago. Acknowledgments are also due to members R. G. Roberts, of Duluth, and Charles J. Lund, of Minneapolis, for their kindness in forwarding local newspaper reports and interesting photographs.

Mr. Hawes writes:

In the business district of Cloquet no building is standing. Brick walls all collapsed and nothing but piles of brick, ashes and rubbish mark the commercial center of the town. Yet in the City Hall the rubber was not melted out of an electric light push switch in at least one instance.

"As to temperatures developed, cast iron melted freely in many places—radiators, bath tubs and stoves giving general testimony to this fact. Brass and copper, of course, were generally found melted, and in one place, in a one-story frame building, a typewriter was found with its cast-iron and steel parts melted and run together into an almost unrecognizable mass.

"Photo is here shown of a hydrant some fifteen feet to windward from any building—and across the street from any other building. Yet the brass bushings are completely melted out, allowing the pipe caps to drop out. This must have been in some 1,800 degrees of heat and it is doubtful if any flame reached it at all.

"The magnificent new High School—less than a year old—was totally destroyed. But several blocks further to windward an older school building—one they were about to tear down—came through with just one window broken. The houses on three sides of it burned.

"There was a bicycle lying in a front yard, within 8 or 10 feet of where a porch had been. The rear wheel, tire, rim and spokes were a hopeless mass. The front wheel was all ready to be part of a perfect bicycle.

"There were yards and hedges as pretty as they ever were, with the houses entirely gone; and again there were fire-swept blocks with not a spear of grass and with the shade trees burned into a crescent-shaped shell.

"Telephone poles were burned off in many instances 8 to 15 feet above the ground, with no signs of fire around their base. This occurred so often as to indicate quite conclusively the existence of a very hot heat current at about this height above the ground. In other places telephone poles and fence posts were burned clear out of the ground—nothing remaining but an empty hole, with a few pieces of charcoal and ashes at times in the bottom of it.

"At the High School, although directly in the path of the flames, the flag pole stood unscathed, and its rope halyard beat out its rattling tattoo of bleak loneliness as if nothing had happened.

"There is no accounting for the strange things the fire did and did not do.

"The gasoline tanks—two huge storage tanks—came through the terrific heat and flame of surrounding smaller barrels and drums, which burnt, as if they understood that they would be called upon on the morrow to supply power to the rescuing angels of mercy—the automobiles.

"A one-story 12-inch wall garage building went all to pieces. A section of its wall is herewith illustrated.

"One of the prominent men of the town took a trunk out and buried it about fifty feet from his home and under two feet of dirt. He was one of the first to get back to Cloquet. The town was gone, of course. When he went to get his trunk he found a depression in the ground, and his spade brought up the iron hoops which had surrounded it."

Department of Fire Record.

Japan and Lacquer Hazards—Fire Record.

Following the plan of the study of fuel oil hazards presented in the QUARTERLY for July, 1918, an analysis is now offered of the hazards of japanning and lacquering. The recent holocaust in a Newark button factory, in which the rapid spread of a lacquer fire was responsible for the loss of many lives, has aroused considerable interest in the hazards of lacquering, and as the number of fires attributed to this process was comparatively small, it was thought well to make at the same time a study of japanning. Enameling is not included in the record, nor are fires in dip tanks where definite information was lacking as to the character of the dipping fluid used. It will be observed that the two groups of hazards are kept distinct throughout the record.

The large proportion of heavy losses resulting from lacquer fires is partly due to the fact that lacquering has quite commonly been done in factories of inferior construction without proper facilities, whereas most of the japan fires reported occurred in large and well-equipped plants. It is also to be borne in mind that the solvents used in the preparation of lacquer differ widely and that users do not always take the trouble to acquaint themselves with the properties of the fluids they are handling. To a very large extent the hazard of a lacquer is the hazard of the solvent.

Prominent among the points of interest in connection with the record stands out the necessity for constant and expert attention to the ventilation of ovens. Undoubtedly a large proportion of the explosions in ovens was attributable to neglect of this feature, although this might not always be easy to prove. Adequate means of ventilation not dependent upon the memory or intelligence of an attendant are in the highest degree desirable from the life and fire safety standpoints. Ventilating pipes and flues should be regularly cleaned and inspected for defects.

The superiority of methods of heating which do not involve the use of an open flame in close proximity to the oven is clearly demonstrated.

Several of the fires selected for special mention illustrate this point in detail, and also the additional hazard connected with the gas-heated oven, viz., the possibility of an explosion from escaping fuel gas. Where open flame heating is installed it is particularly important to isolate adjoining ovens from each other to the end that trouble occurring in one may not spread to the rest.

It ought not to be necessary to emphasize the danger of so locating ovens and dip tanks that a fire occurring at the former can readily flash back to the latter. It appears, however, that in many plants this serious hazard has been given little or no consideration. Good practice requires not only that dipping and baking should be isolated from each other, but that both should be conducted in rooms properly cut off from the rest of the plant.

Chemical extinguishers, particularly of the foam type, and suitable mixtures of sawdust and soda are of the utmost value in extinguishing japan and lacquer fires. While automatic sprinklers are necessary to keep down the temperatures and to prevent the spread of fires to other portions of the plant, the application of water in quantities is apt to spread the burning japan or lacquer. There would seem to be a need for more thorough instruction of employees generally as to the most effective means of fighting, as well as preventing, fires in these hazardous liquids.

Japan and Lacquer Fires.

1. Analysis of Loss.

	No Claim		Small Loss		Large Loss		No Data		Total
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.
Japan	26	20	91	70	7	5	7	5	131
Lacquer	4	9	28	65	9	21	2	5	43
	30		119		16		9		174

2. Classification of Causes.

Japan Fires.

	No. of Fires	Per Cent. of Whole
Overheated oven	22	16.8
Explosions at oven	20	15.3
Smoking, matches or open flame in presence of japan	17	13.0
Heat from oven igniting combustible material nearby	12	9.2
Defective, dirty or overheated flues	7	5.3
Accidental sparks igniting japan or its vapors	6	4.6
Fumes from oven ignited by open flame nearby	5	3.8
Ignition of vapors from miscellaneous causes	5	3.8
Spark or flame from oven burners	4	3.1
Drippings igniting in oven	4	3.1
Accumulations of vapor due to poor ventilation of oven	4	3.1
Coating on stock ignited in oven	4	3.1
Stock placed in oven before properly dried	3	2.2
Carelessness in cleaning	3	2.2
Miscellaneous causes	15	11.4
Total	131	100.0

Lacquer Fires.

	No. of Fires	Per Cent. of Whole
Matches or open flame in presence of lacquer	14	32.6
Accidental sparks ignited lacquer or its vapors	7	16.3
Lacquer spilled on hot pipes, etc.	4	9.3
Overheated ovens	3	7.0
Spontaneous combustion of lacquer refuse, etc.	4	9.3
In lacquer dry box	2	4.6
Miscellaneous causes	9	20.9
Total	43	100.0

Details of Causes.

Japan Fires.

Open Flames, Etc.

S-2061. Open gas jets were located over two uncovered dip tanks. In lighting one of the gas jets an employee dropped a lighted match into a tank. The loss amounted to about $4,300.

S-11247. Metal parts were dipped and hung on iron rods over a metal table. A swinging gas jet at the side of the table was used to keep the parts slightly warm. On the occasion of the fire the jet was swung too close and ignited vapors from the japan. The fire was extinguished with small loss.

S-13517. The night watchman discovered a leak at a japan dipping tank. A pool of japan mixture had accumulated on the floor, and the vapors from this were ignited by the watchman's lantern. Fire spread to japan drips and japan in tank nearby. Thirty-nine sprinklers operated and practically extinguished the blaze. The loss was about $500.

H-10166. Vapor from a japan dip tank floated through the air to a coke furnace in the next room, which was used to heat a japan oven. The rooms were not cut off in a standard manner, and fire flashed back to the tank, doing damage to the extent of $1,367.

H-10616. An employee used a very short taper to light the gas jet of a bake oven, and consequently burned his fingers. He threw the taper away and it fell into a nearby dip tank containing about 20 gallons of japan. The loss was $972.

Heat from Ovens.

S-114. A brick japan oven was built against a wooden wall. It it believed that the wood in contact with the oven became charred and that a spark escaping between the bricks of a chimney with which the wall was also in contact readily set the wood afire.

S-169. A sheet-iron bake oven for japanned goods was heated by a coal stove located inside it, but fed from the outside through an iron door. A shelf carrying wooden boxes had been placed close to the oven, which was stated to become very hot at times, and fire occurred in one of these boxes.

S-11527. A metal gas-heated japan drying oven had a 3-inch cement floor laid direct on the wooden floor below. Heat from the burners penetrated the cement and set fire to the wood underneath.

H-7223. This oven was set on a brick base over wooden flooring. The brickwork was probably poorly installed, leaving crevices

through which the heat could strike directly against the floor. Fire was discovered while still smouldering and was extinguished without loss.

In Vent Pipes.

H-9721. Considerable soot accumulated in the vapor flue connected to the hood of a japan oven. This caught fire and, as the flue was in contact with a wooden wall, flames communicated to the building.

S-12823. Fire occurred in a 17-inch vent pipe which communicated with smaller pipes from the hoods over four japan ovens. Undoubtedly the pipe contained an accumulation of semi-solids from condensation of japan vapors, and these in some way became ignited. After the fire, cleaning holes with slide covers were made in the pipes with the object of preventing a recurrence of the hazardous condition. The loss was about $425.

Cleaning.

S-4831. An employee had just finished dipping and had partially scraped the edges of the tank and drip board, as was his custom. He placed the painter's scraper he was using in the coal stove, and either because the scraper had become excessively hot or because some of the gummed japan had stuck to it and taken fire, the dip tank burst into flames as soon as he commenced scraping again. Losing his head, the man called other employees, and they all proceeded to throw water upon the fire, causing the tank to overflow. An old chemical extinguisher was brought, but no one knew how to use it. Sprinklers operated and held the fire in check, but owing to sheathing on the walls could not wholly extinguish it. The rotary fire pump was put out of commission when the fire burned off the main belt just above the friction gears. This fell down around the gears, and the pump could not be started again until the debris had been removed. The loss was in excess of $2,000.

S-5366. Drip racks above dip tanks were being scraped by employee with a hot shovel when fire flashed from the tanks. He probably struck a spark in the process, thus causing the blaze. The loss was between $4,000 and $5,000.

S-20389. Disregarding his instructions, a night oven-tender was using a pail of gasoline to clean japan from the floor near a lighted oven. Explosive vapors were drawn into the oven by the draft through the oven ventilators and ignited, setting fire to the pail of gasoline and japan in drip pans and dip tanks. Twenty-six sprinklers operated promptly and controlled the fire.

Miscellaneous.

H-13039. Three gas-fired ovens were installed with direct communication between them near the floor beneath the burners. One of the ovens was not in operation at the time of the fire, and it is supposed that one of the gas cocks in that oven was not closed tightly and allowed gas to escape into the adjoining oven, where it became ignited.

S-14011. It was customary at this plant to spread papers on the floor at the front of the japan oven to catch drippings. When the door was opened paper on the floor caught fire in contact with the gas flame of the burner. Fire blazed up, but was extinguished by ten sprinklers.

Lacquer Fires.

Open Flames, Etc.

H-505. Small metal parts were put in wire baskets and dipped bodily in a metal tank 18 x 18 x 10 inches. They were then set on a drip board and later placed in a small tin steam-heated drier. The lacquering department was working late by gaslight, but for some reason an employee lighted a candle, and in working near the small dip tank either dropped the candle into one of the wire baskets or set a basket on fire. The drip board and lacquer burst into flame with a roar, and four employees who heard the noise and attempted to use a standpipe hose were driven back by the smoke. The flames spread rapidly, travelled up an open elevator shaft into a blind attic and finally through the roof, gutting the two top floors. The loss was about $45,000.

S-5245. A boy lacquering a small can at a dip tank lit a match to examine the inside of the work and thus ignited fumes from the tank. Flames were drawn by fan into a wood ventilating duct. The loss was about $588.

H-1677. Lacquering room contained a sheet-iron oven about 6 feet square, heated by gas jets underneath. The girl who was working in the room at the time described the start of the fire as like an explosion or flash. Apparently the blaze originated with the ignition at the gas jets of vapor from lacquer which was being heated in a pot of hot water near the oven. The loss was $7,950.

S-11530. A plumber was putting in a metal hood and fan in connection with the ventilation of acid kettles, when a spark from his charcoal furnace set fire to dried lacquer on the outside of an earthen dipping crock containing about 20 gallons of thinner. Someone raised the cover of the crock to see whether the fire had got inside. The contents promptly ignited, generating sufficient heat to crack a crock of similar size alongside containing lacquer, which also took fire. Sprinklers operated promptly and prevented serious damage.

S-20501. A girl was putting lacquer on small work in front of an exhaust fan, and turned away for a moment to bring additional work within easy reach, when a burst of flame occurred. It is supposed that vapor from her lacquer brush was ignited by a spark from the chimney of a neighboring property or by a hot bearing on the motor driving the exhaust fan. The damage was slight.

H-12729. A workman stepped on a match in the lacquer room. The room had wooden partitions and the building as a whole was of brick with wood joists and wood trusses. The loss amounted to $48,338.

In Vent Pipe.

S-19469. A suction system had been installed for drawing off vapors from hoods in lacquering department. Fire occurred in a duct, probably as the result of spontaneous ignition. Pyroxylin as well as gum lacquers were used, and at times cloths used by the men for wiping off lacquer were drawn into the pipe. It is believed that one of these ignited spontaneously in the duct. The loss was $1,500.

Lacquering Machine.

S-22605. Fire occurred in an electrically heated automatic lacquering machine and was due to too much heat in the enclosed box through which the carriers passed, the lacquer on the socket shells drying too quickly, and the vapors therefrom becoming ignited. As three machines were connected to a single exhaust, the flames spread to the two other machines. One sprinkler operated, however, and practically extinguished the fire.

Miscellaneous.

S-2887. Low voltage electric wires for electro-plating ran through the lacquer dipping room. A boy was dipping ladies' metal chatelaine bags and hanging them on a wire to dry before being placed in the dry room. While the bags were dripping someone struck the wire, causing the bags to swing to and fro. In this way lacquer drippings fell on the electro-plating wires, causing a short circuit and a flash of fire. The loss was slight.

H-11890. Black amyl acetate lacquer was used at three small pumps which were not, however, properly isolated. There were hoods and an exhaust fan at the lacquering bench. The process was being moved to another part of the building and a workman in tearing away the hoods struck a spark with his hammer against the brickwork. An accumulation of wasted lacquer was ignited, causing much smoke, which drove away the men who tried to extinguish the fire with hand extinguishers. The fire spread to other floors through unprotected vertical openings, resulting in $15,000 damage.

Points of Interest from Fire Reports.

Japan Fires.

Ventilation.

S-19436. The oven in which explosion occurred was constructed of brick and heated by fuel oil, which was burned in a flue under the floor provided with iron-plate covering. It was the practice to keep a damper open in the ventilating flue of the oven when the work was first put in, the damper being closed gradually as the baking progressed,

although the intention was never to have it completely closed. The chances are that at the time of the explosion the damper had been fully closed by mistake, allowing an accumulation of gases which formed an explosive mixture with air. The property damage, which was all due to the explosion, amounted to $2,000.

S-19848. Smoke was seen issuing from the oven, but nothing was done to extinguish the fire, although chemical extinguishers and sand were made ready for use in case they should be found necessary. The blaze was out in about an hour. The oven was electrically heated and was not ventilated. After the fire baking in this oven was discontinued pending the installation of ventilators.

S-22310. Fire occurred in an oven which had just been filled with goods to be baked. The adjoining oven was in full operation at the time and the two ovens had a common vent. Evidently fumes from the newly-filled oven were ignited in the vent by heat from the other oven, and fire flashed back, igniting fresh japan on stock.

Extinguishment.

S-13694. The cause of this fire was probably smoking by an employee who was cleaning the drip boards of a dip tank containing 300 gallons of japan. The alarm was given by the employee rushing out of the room with his clothes aflame. Another employee ran up from the floor below to see what was wrong, and closed the fire door before the fusible link operated. The japan building was a 2-story structure cut off from the rest of the plant by a fire wall and standard fire door on the west and by a blank wall on the south and north sides. The east wall contained one window, and on the second floor there was a door opening to the outside of the building. Water from sprinklers and hose streams spread the burning mixture, which began to pour out of the doorway down an outside stairway to a coal pile in the yard, and thence through an open door into the boiler house. In the boiler house was located a covered well which had formerly been used for supplying boilers. The lighted japan floating on the water poured into the well through a small opening in the top, and when confined in the well caused an explosion which tore up a small portion of concrete floor. All the sprinkler heads in the boiler room then operated.

At the same time the burning japan ran down the sides of the dip tank, which extended into the floor below, where painting was done, and although the fire doors were closed, the burning japan passed through a small space between the wall and a fire door into the adjoining building, causing sprinklers to operate. It then worked its way around large barrels of paint and a dip tank and under fire doors leading into the stock warehouse, but was finally checked at this point before sprinklers operated.

The sprinklers played a very important part in preventing damage to the building, the only part burned or charred being a window sill.

S-16183. Fire occurred from unknown cause at japan dip tank, and although sprinklers and hose streams prevented the flames from

spreading, they had no effect upon the fire in the tank, which was allowed to burn itself out. The metal cover provided for the tank was not automatic, and it was removed during the day when the tank was in use. Sheet iron placed over the tank by the fire department proved of little value, and as the tank was not provided with a drain it could not be emptied. There was little direct fire loss, but the water loss was quite heavy, amounting to about $6,900.

S-19001. The chief feature of this japan fire, which was extinguished with a loss of but $67, was the high efficiency of sawdust as an extinguishing agent.

Miscellaneous.

S-13688. Explosion occurred in a one-story corrugated iron building having a concrete floor 4 inches thick with a 4-foot space beneath. The western wall of this building was of concrete, 4 inches thick, parapetted 3 feet at sides and roof. At this end there was an opening to a pass connecting with the first story of the basement and 3-story main mill, the opening being protected by an automatic sliding door. At the eastern end of the building were located three ovens, one heated by steam coils on the floor, while the remaining two were heated by hard coal fires from ovens placed under the main floor and having domes of fire brick over which heavy sheet iron was placed, but not fastened at the edges. These ovens were fired from the ground level and surrounded by a "lean-to" of corrugated iron on wood frame. Dipping was done in the afternoon and stock placed in the ovens, where it remained overnight. The fires were not replenished at night. At about 10.25 the corrugated iron building was completely demolished by an explosion, which also broke a number of windows in the main building. The cause of the explosion could not be definitely determined, but it is probable that in some way gases or drippings from the ovens found their way to the coal fires below. If it was considered necessary to adopt this hazardous method of heating, the domes over the fires should have been of heavy cast-iron and should have been made tight at the edges.

H-10810. In this case the heating apparatus for the oven consisted of two 1¼-inch perforated gas pipe burners. The firing chamber was not properly cut off from the baking chamber, but there was a removable sheet-iron plate above the burners. The baking chamber was vented by a 4-inch metal stove pipe upward and away from the oven about 8 feet. It then joined the smoke pipe from a forge hood, the common pipe being connected to a brick chimney. At the time of the explosion the oven was not lighted, but the gas cock had been accidentally turned on. The accumulation of gas in the oven was undoubtedly ignited by the back fire from the smoke pipe from the forge. The oven was completely demolished and an employee received fatal injuries.

H-12233. Japanning processes were not cut off and the building as a whole was unsuited to its occupancy, being brick joisted construction. All floors in the japanning section were thickly encrusted with paint and oils, and fire spread very rapidly. The loss was $87,545.

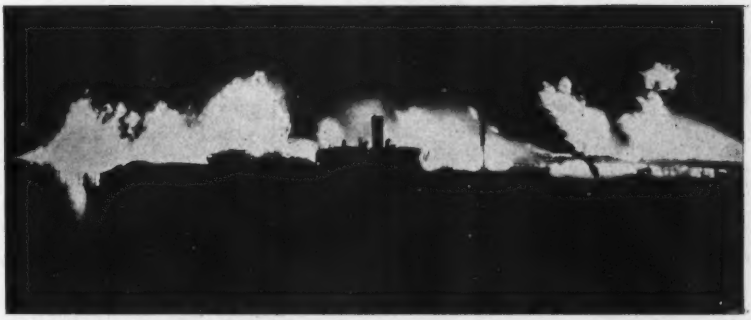
Lacquer Fires.

Extinguishment.

S-10253. The lacquer room at this plant was not properly cut off, being located against the east wall of the building and enclosed only by a wood, part glass, partition. It had a wood ceiling and contained three dip tanks. A spark, attributed to defective electric wiring, was seen by employees to fall from the ceiling into one of the dip tanks. Almost immediately the contents of the tank caught fire, communicating the flames to the other two tanks. The rapidity of combustion gave the appearance of an explosion, and the window at the east end of the room was shattered. The partition and ceiling ignited, and intense heat was generated with much smoke, which drove employees from the rooms. Two men who delayed were overcome and suffocated.

At the time of the fire the sprinkler system was shut off, while a leak in the underground supply pipe was being repaired in the yard. It was about five minutes before water could be turned on, and the fire gained such headway that 325 sprinklers operated. Notwithstanding the lack of horizontal cut-offs and the poor protection of vertical openings, the sprinklers were effective in preventing the spread of the fire. The loss of $10,218 included $7,450 in respect of damage to machinery and stock, but in all probability, without sprinkler equipment, there would have been an almost total loss.

S-19124. Fire started in a lacquer tank from some one lighting a match. A sprinkler operated immediately above the tank and caused the lacquer to overflow and spread flames into an adjoining room. The fire was, however, confined to a small area on the concrete floor by a dam of sawdust and soda, and it was then smothered with an old cloth. The loss was slight.



Courtesy Fire Marshal H. W. Bringhurst

Fig. 1. Photograph taken from northeast at height of Seattle Dock Fire. On extreme left nothing is burning but oil on the water. The large vessel is the *Fushima Maru;* just north of her is the stack of the fire boat *Duwamish.* Fire wall is on extreme right. High on right is a manifestation of gas from vegetable oil with a flash point of about 565°.

Vegetable Oil Dock Fire, Seattle.

October 15, 1918.

Special Report by A. S. Wheeler, Engineer, Washington Surveying and Rating Bureau
(Member N. F. P. A.)

Fire was discovered at about 10.55 p.m. in the Great Northern Railway Company's frame vegetable oil dock, located at Smith's Cove at the northern limits of the Seattle waterfront. The entire dock was destroyed, with a total loss of approximately $1,400,000.00.

The dock adjoined the Great Northern Railway Company's elevator dock on the south, with a blank rising fire wall between. At a distance of 440 feet west across an open waterway is located the Smith's Cove Dock of the Port of Seattle Commission, and 240 feet east across the Great Northern waterway is located the Great Northern Seattle Dock. The distance to the Port Commission Dock is reduced to 320 feet at the point where the wood stave vegetable oil tanks described below are built on piling over water immediately west of the oil dock, there being also a 20-foot open wharf on the east side of the Port Commission Dock; the distance between the Great Northern Oil Dock and the Seattle Dock is only 192 feet if measured between the open wharves along either side of the waterway. The docks extend south from the shore line into Elliott Bay over rock and sand fill.

Noteworthy features in the fire defense were the prevention of spread of fire to the north by the fire wall above mentioned, and the efficiency of turret nozzles on the fire boats and hose streams played directly on the floating oil under favorable wind and tide conditions in preventing spread of fire from large quantities of oil burning on the surface of the water to the docks across the waterways.

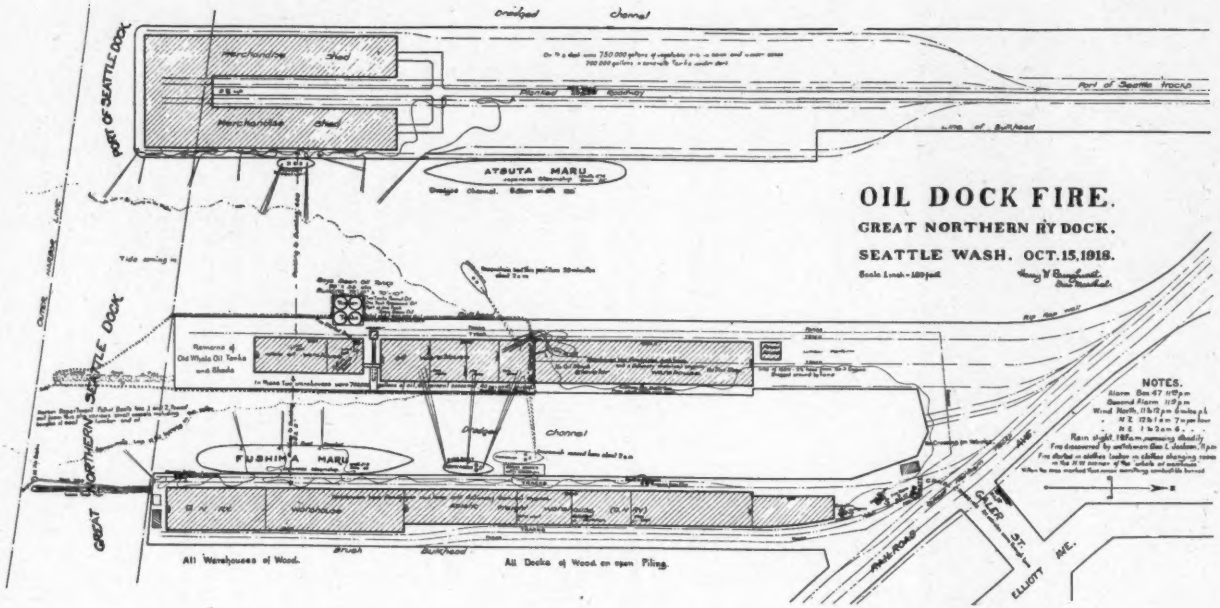


Fig. 2. On this drawing Fire Marshal Bringhurst has noted interesting points connected with the fighting of the fire and the spread of the burning oil.

Construction and Occupancy.

The burned oil dock consisted of two main buildings and wooden oil tanks as follows: North building, one story frame, 100 feet by 350 feet, adjoining tile fire wall on the south; corrugated iron sides on wood studding; composition roof over 1⅝-inch tongued and grooved 3½-inch single plank floor; divided into four sections by double 1⅝-inch tongued and grooved partitions with automatic doors of same construction.

Forty-two feet south of the above building was located what was formerly the fish oil dock, but had for some time past been used for vegetable oil. This building was one story frame, 80 feet by 260 feet in dimensions and of practically the same construction as the above building, except that shiplap siding was used instead of corrugated iron. It was divided into two sections by double 1⅝-inch tongued and grooved partition with protected communications.

These buildings were on posts and piling over rock and sand fill and water, with about 5-foot average open space underneath. An open wharf, 20 feet wide, extended the entire length of the dock over water on the east in continuation of main floors of buildings, without bulkheading of any sort under wharf or buildings. Railroad track on fill was adjacent to west side of dock.

Twenty-nine feet west of the north end of the south building were located four vegetable oil tanks of wood stave construction supported on piling over water and covered by a frame composition roof enclosure. The capacity of each tank was approximately 120,000 gallons—total, 480,000 gallons.

The wood stave whale oil tanks of 300,000 gallons total capacity at the south end of the dock had recently been removed.

The dock was used for storage and handling of vegetable oil, mostly in cases and to a small extent in wooden barrels, the wooden cases containing two five-gallon oil cans each with soldered caps. The usual warming rooms, emptying tables and pumping apparatus were present.

About 70,000 cases of cocoanut, peanut, soya bean and rape seed oil were stored on the dock inside, between and under buildings at time of fire. Approximately 60 per cent. of this was cocoanut oil. Two of the wooden tanks were filled with peanut oil, one with rape seed oil, and the fourth contained about two feet of soya bean oil, approximately 370,000 gallons in all.

The wharf, floors and woodwork were oil-soaked.

The Great Northern Elevator Dock (saved) is a two-story frame structure, with elevator in central portion equal to ten stories, 100 feet by 500 feet in one fire area, adjoining the above mentioned fire wall on the north; composition roof; walls corrugated iron clad; ten-foot awning along west side entire length, made up of wood frame with composition roofing and metal covering underneath. Building is on piling 4 to 10 feet above fill except east portion, with 20-foot open wharf beyond on piling over water in continuation of wharf adjoining oil dock.

It is used for general Oriental merchandise storage.

Fire Wall.

The fire wall was constructed of hollow interlocking tile with concrete coping, forming fire barrier between oil and elevator docks. It is 20 inches thick up to eaves at the level of the oil dock, the remainder being 16 inches thick except the east 18 feet, including a 2-foot outward projection, where it is 4 inches thinner throughout. The former section is built on solid concrete foundation in the ground; the latter is supported on an 18 x 18-inch creosoted wooden beam supported by a timbered cantilever structure. The entire cantilever structure is surrounded by a tight 6-inch wooden bulkhead from wharf down to ground and low tide level, the bulkheading extending out to the extreme east edge of the open wharf.

The tile wall projects two feet beyond east building line and two feet beyond frame and corrugated iron sides of texas over elevator dock. On the west building line the wall is extended north at a right angle five feet.

The wall rises six feet above the roof of the oil dock at its lowest point and 32 inches above the main roof and texas of the elevator dock at lowest points, stepping down to follow the contour of the higher roof.

No pilasters in wall, but non-bearing.

Exposed Docks Across Waterways.

Westward across an open waterway, at a distance of 440 feet, is the one-story frame sprinklered dock of the Port Commission paralleling the oil dock for approximately 600 feet, with freight and vegetable oil wharf of the Port Commission extending north for approximately 1200 feet.

The roof of the dock building is composition and the sides are corrugated iron clad; dock and wharf on piling and posts over fill and water, open around on east, south and west.

Eastward across an open waterway, at a distance of 240 feet, is the Great Northern Seattle Dock, one-story frame with a small two-story office portion; total length 1525 feet; composition roof; sides corrugated iron clad. The building is on piling over rock and sand fill, except the west portion and a 30-foot open wharf adjacent on piling over water.

Fire Protection.

There was good inside hydrant protection in the burned oil dock buildings, consisting of 50 to 100 feet of 2½-inch hose attached to standpipes in each section, supplied by 4-inch from 6-inch line from city main, giving static pressure of approximately 130 pounds per square inch. Water barrels and pails and tubs of sand were available, also 2½-gallon soda and acid extinguishers well distributed. There was no outside hydrant protection, either private or public, except city hydrants north of Great Northern Seattle Dock, the nearest over 1400 feet distant.

The Great Northern Elevator Dock has 2-inch inside hydrants, well spaced, supplied by 6-inch from city main, but no outside protection,

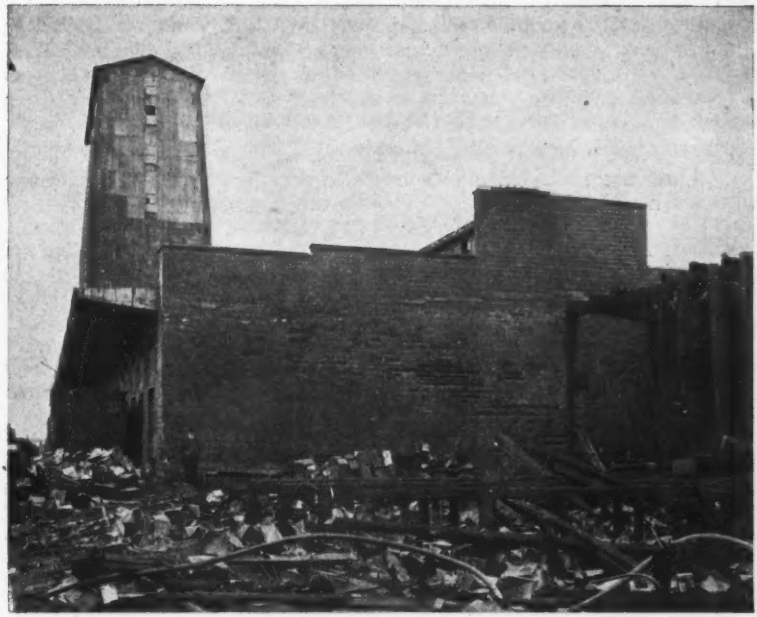


Fig. 3. The hollow tile fire wall which saved the elevator dock. Note spalling.

private or public, except city hydrants located north of the Great Northern Seattle Dock, the nearest 900 feet distant.

The dock building of the Port of Seattle Commission Dock and Wharf is thoroughly sprinklered. There is a good inside hydrant system with hose attached. Outside hydrants are well spaced, but no hose was provided for their use up to time of fire. There are seven monitor nozzles through the center of the freight and oil wharf. The water supply is from a city main, and is ample.

The Great Northern Seattle Dock has two and one-half-inch inside hydrants with hose attached, supplied by 8-inch reduced to 6-inch from 20-inch main on Elliott Avenue. There is a city hydrant on the 8-inch main immediately north of the dock and another on the 20-inch main within 600 feet north.

City Fire Department.

There are two fire boats, the steel boat Duwamish, capacity 8,000 gallons per minute, and the Snoqualmie, with wooden hull, capacity approximately 4,000 gallons per minute. They are located about 15 and 25 minutes' run respectively from moorings to Smith's Cove.

Fire engines are able to reach any portion of the Port Commission terminal and travel the entire length of the wharf on the west side of

the Great Northern Seattle Dock, but the oil and elevator docks were not accessible to vehicles and could be reached only with difficulty by the fire department on shore by carrying and dragging the hose by hand from a hydrant north of the Great Northern Seattle Dock. It was about seven minutes' run for the nearest fire engine to Smith's Cove and four minutes for the nearest hose company.

Watchman Service.

Three night watchmen without clocks patrolled the oil dock and one watchman without clock the elevator dock.

Fire Alarm.

The nearest fire alarm box is located about 200 feet north of the Great Northern Seattle Dock, with seven auxiliary fire alarm boxes in the elevator, but no boxes were installed in the oil dock.

General Conditions at Time of Fire.

The weather was cloudy, with a very light north wind. It was high water at about 1.30 a.m. October 16th, and very little tide movement occurred until after the danger of a conflagration was over.

The waterways are virtually channels between the filled ground under the entire length of the three docks, limiting the tide to a generally lengthwise instead of a crosswise movement with reference to the docks, except across the outer ends.

A Japanese liner, the *Atsuta Maru,* was tied up to the Port Commission freight wharf opposite the fire wall, and another, the *Fushima Maru,* opposite the oil dock across the Great Northern slip.

The Fire.

Fire was discovered about 10.55 p.m. October 15th in the north end of the south building of the oil dock, and is believed to have started in the dressing room in the northwest corner used by employees.

One of the negro watchmen states that he was walking along the wharf on the east side of the dock when he saw a light in the window of the dressing room and, entering the building, located the fire in the southwest corner of the dressing room, apparently from one of the lockers, but possibly coming up through the floor. He whistled to call the other watchmen and threw a pail of sand on the fire without much effect, then stretched out a length of hose and turned the water on. The other negro watchman in the boiler room at the south end of the dock responded to the call and telephoned the alarm, telling Central to send the fire boat. He returned to help fight the fire, and then ran to the elevator and turned in the alarm at 11.06 p.m. through one of the auxiliary fire alarm boxes stationed there. When he came back the men were driven out of the building. The third watchman, an elderly white man, stationed at the oil tanks, noticed the reflection of fire through the window from inside the tank enclosure and, running out, found the fire just breaking through the north end of the building. He shouted to call the attention of the other watchmen, one of whom, he states, ran to the elevator to turn in the alarm, but he made no effort to fight the flames, as they had gained such headway that he was forced to seek safety.

The two negro watchmen, with the assistance of the Great Northern watchmen, fought the fire for a while in the north building of the oil dock until they were driven away.

The fire boat Duwamish arrived at 11.23 p.m., and the first fire apparatus on shore, a hose company, at 11.10 p.m. The second alarm was turned in at 11.13 p.m. calling the fire boat Snoqualmie, which arrived at 11.38 p.m., and the fire engines, the first of which arrived at 11.20 p.m.

The hose wagon which arrived first went down the Great Northern Seattle Dock, as there was no approach to the dock on fire, and before getting into action was transferred to protect the Port Commission Dock on the arrival of other apparatus. The first fire engine to arrive was delayed five or six minutes in getting located, wrong instructions being given by a policeman owing to the confusion. By the time the fire boat Duwamish arrived the fire had spread the entire length of the oil dock up to the fire wall, and the fire fighting became entirely a question of protecting exposed property.

Men were sent to man the 2-inch hose streams at south end of the elevator dock, where two lines of 2-inch hose were used to protect the awning and roof and under wharf on the north side of the fire wall. These two lines of 2-inch hose were used for probably thirty minutes before a single 2½-inch line was stretched from the hydrant north of the Seattle dock. It is stated that it required about twenty minutes to lay the 2½-inch line to the fire wall, with the help of civilians called on to assist the firemen. This line was about 1500 feet long and had to be dragged and carried by hand the entire distance. By the time the 2½-inch line was put in service the fire was being held with great difficulty with the 2-inch inside hose streams, especially under the wharf just north of the wooden bulkheading, where it had burned through in places.

Meanwhile two pumping engines were stationed on the wharf of the Great Northern Seattle dock and the fire boat Duwamish tied up to a coal barge alongside the *Fushima Maru* and about 250 feet south of the fire wall. Burning oil was flowing into the water along the entire length of the oil dock on this side, but this was kept at a safe distance without difficulty by means of the high pressure turret nozzles and hose streams. Inside hose lines in the Seattle dock, several of which burst when water was turned on, were also used to protect the Japanese liner and the dock and wharf from the intense heat. The turret nozzles on the fire boat were concentrated most of the time immediately south of the fire wall and on the wooden bulkheading under the wharf, the fire boat moving north for the purpose of better protecting this barrier. To give much-needed assistance to the firemen in the elevator dock, a hose stream was later run from the Duwamish by means of a row boat, and played at close range on the bulkheading.

On the west side of the oil dock oil was also running into the water from the buildings, but the great danger was from the large quantities of oil stored in the wooden tanks. The tanks caught fire in a comparatively short time, and by 11.30 p.m., by reason of the large amounts of

oil emptying at this point, oil had spread to within about 80 feet of the Port Commission dock. It was kept back by the hose company first mentioned, with the assistance of the dock employees, until the arrival of the fire boat Snoqualmie at 11.38 p.m., when the high pressure turret nozzles beat back the burning oil to a safe distance. The high pressure streams were very effective in driving back the oil and smothered the fire to some extent around the outside, and although the Port Commission dock was seriously threatened at times, it was apparently only a question of applying a sufficient number of high pressure streams to keep the fire at a safe distance. The intense heat and the air currents resulting therefrom made the fire fighting most difficult at close range. Dock employees assisted materially in drenching the roof and exposed side of the dock with hose and the freight and oil wharf and the *Atsuta Maru* with the monitor nozzles.

When the oil fire on this side appeared to be about at its worst and the dock in serious danger, additional streams from the fire boat were brought directly into play from the wharf, and the fire was completely smothered in two or three minutes within range of the hose streams. This was followed by a dying out of the oil fire across the waterway, except for two or three large patches and a large body of oil around the burning tanks. The danger was thought to be over, so far as the Port Dock was concerned, but about ten or fifteen minutes later the fire again spread over the water from the tanks, which now had given way entirely, to within about 75 feet of the wharf. Within a few minutes the danger was past and a large patch of burning oil was carried by the tide out into the Bay directly to the south of the Port Dock. This was probably 800 or 900 feet away before it burned out.

A very spectacular feature was the whirling effect caused by the heated air currents setting up "water spouts" of flaming gas from the burning oil ten to fifteen feet in diameter and several hundred feet high, raising the surface of the water and oil for a height of two or three feet around the bottom of the "spouts." The roaring of the "water spouts" could be heard a considerable distance.

As soon as the danger was over at the Port Commission Dock, the fire boat Snoqualmie moved over to assist in holding the fire at the west of the fire wall, but was grounded some distance out and soon forced to leave this point on account of the ebbing tide.

The danger was not entirely past so far as holding the fire at the wall was concerned until about 3.00 a.m., owing to the large amount of cased oil stored in the compartment or section of dock, which continued to burn south of the wall.

The tile fire wall stood up well under this severe exposure, although it spalled badly over most of the surface, breaking off the outer web of the tile. It was responsible for stopping the fire at this line. The slight north wind, however, was favorable, and the fire would unquestionably have taken the elevator dock if an unfavorable wind had been blowing. Also, without the fire boat protection and the splendid work

Fig. 4. General view of the ruins after the fire.

of the firemen, who fought close up behind the fire wall with low-pressure streams, the elevator dock would have been doomed.

The entire oil dock was destroyed, but considerable oil is now being salvaged from unburned oil on the surface of the water at the head of the Great Northern slip and oil remaining on the dock in partly emptied cans.

The total loss is approximately $1,400,000.00—oil in cases valued at $750,000.00, in oil tanks at $500,000.00; value of oil dock and tanks, $100,000.00.

The elevator dock contained general merchandise to the value of approximately $1,200,000.00, and the building was valued at approximately $200,000.00. The damage to this dock is negligible.

The paint on the *Fushima Maru* was badly scorched as well as on the fire boat *Duwamish*.

Conclusions.

The fire department held the fire as well as could be expected under the circumstances. The oil dock was doomed before effective means of combatting the fire could be brought into action, largely as a result of its remote location and lack of proper means of approach from land to the elevator and oil docks. Credit is due to the fire department, chiefly to the fire boats, for preventing the spread of the fire to the valuable docks exposed.

The conditions, however, were favorable except for the meagre fire protection available from the land. That there was not a most serious conflagration was due largely to chance.

The fire should be taken as an object lesson for the safeguarding of such oil storage in the future, and with this in mind the following recommendations are made:

Oils in such large quantities should not be stored or handled in such a way that they will directly expose or flow without restraint toward exposed property either by land or water.

The storage and handling of vegetable and fish oil cargoes at miscellaneous freight docks should be prohibited.

Such oils should be restricted to docks handling oil cargoes only, especially safeguarded and provided with permanent embankments or retaining walls to prevent the flow of oil from the premises where there is present or probable future danger of exposing valuable properties.

Fire walls protecting adjacent property should be extended so as fully to cut off the exposure.

Fire walls should be provided dividing such docks into two or more fire areas to prevent excessively large losses on the docks themselves. Cased oil stored in the open on land should be safeguarded as well by being divided into blocks with wide separating alleys and surrounded with embankments or retaining walls. Instead of wide alleys, rising fire walls properly buttressed could be used to divide cased storage into two or more lots, forming more effective fire barriers and saving valuable space.

From the exposure standpoint, wooden oil tanks should be treated as more dangerous than cased oil storage. Although fires are not so likely to originate in tank storage, the individual cans tend to hold back the oil, while the wooden tanks release their entire contents within a comparatively short time, creating a most formidable situation. Steel tanks on piling over water would, in the event of the supports giving way during a fire, prove as formidable.

The property should be made easily accessible to the fire department and adequate fire protection, both public and private, should be required.

Fire alarm service should be provided.

Dressing rooms, offices, lavatories and all enclosures of this sort where fires commonly originate should be detached or properly cut off.

In addition to safeguarding the oil storage as already outlined, it would be desirable to also protect such docks with automatic sprinklers installed with the unusual conditions in mind. A sprinkler system would be most valuable not only in giving prompt alarm and extinguishing many fires in their incipiency, but in keeping below the burning point the temperature of the surrounding oils in cases.

Fig. 1. Ruins of Aeroplane Factory, Marblehead, showing wall construction.

Aeroplane Factory Fire, Marblehead, Mass.

November 7, 1918.

Special Report by Underwriters' Bureau of New England, Gorham Dana, Manager.
(Member N. F. P. A.)

Fire starting at 6.30 p.m. on November 7, 1918, in or under the Dope or Wing Coating Building of the Burgess Aeroplane Factory at Marblehead spread rapidly to all buildings of the plant, as well as to a boat yard nearby, and destroyed them (with the exception of a dope vault and a couple of sheds), causing practically a total loss.

Location.

The factory was located in the oldest section of the town on the water's edge, with considerable exposure from old frame tenements and a boat yard on three sides, the bay being on the remaining side. Fortunately at the time of the fire a light wind was blowing directly out to sea; otherwise a conflagration would undoubtedly have resulted.

Construction.

Plant consisted of a main building 285 feet by 100 feet in area, one (high) story, with galleries at the westerly end. Walls were steel frame, with brick to a height of 6½ feet, the remainder being plain glass in

steel frame, forming large window area. Roof was 2-inch hard pine on steel purlins supported on steel trusses forming 15-foot bays. Floor was wood, laid on cinder fill. On the east, 4 feet from the main buildings, parallel and connected by two small passes with tin-clad fire doors at main building end, was a Dope Shed (wing coating), this being 143 feet by 30 feet, one story high, walls frame, covered with tin; roof and floor boards on joists, with a space under the floor of 15 inches to 2 feet, this being inaccessible, however. This building was located at the easterly end, while at the westerly end on the north side was a two-story and basement Metal Shop, 50 feet by 60 feet. Walls were frame, covered with tin. Second floor and roof were light plank on timber, while first floor was reinforced concrete, there being a fire-resistive boiler room in the basement.

On the south side of the Main Building, detached 12 feet, but connected by two open frame passes, was a one-story Stock Room Building, 135 feet by 75 feet. Walls were frame, floor plank on timber, with open space underneath, while roof was plank on wood truss.

The balance of plant consists of an old dwelling, with small brick addition, used for office and stock room, which escaped the fire; a one-story frame lumber shed, 40 feet by 30 feet, partly demolished, and adjoining this a one-story all reinforced concrete vault for storage of dope, which fortunately escaped also.

Fifteen feet south of the Stock Room Building was located the one-story frame boat shed, with several yachts in yard.

Occupancy.

The main building was occupied for general assembly. Wings were assembled at the west end and covered with cloth near the middle of building, while the aeroplanes were assembled from here on to the east end of building. General offices for both the Burgess Company and the United States Navy were located in a gallery along the north side up to about the middle of the building.

In the Dope Shed, wings were first painted, then coated with dope which at this plant consisted of a nitro-cellulose compound. Both after painting and after coating, wings were allowed to dry in the open room. Ventilation was by means of a motor-driven airplane propeller sucking air from both the main room and the space under the floor through registers directly out of doors. The main supply of dope was stored in an old reinforced concrete vault in yard, containing on the day after the fire five barrels of dope, two barrels of thinner and two or three barrels of acetate dope stored for experimental purposes. It was the practice of the employees to bring from the vault not over five gallons of dope at a time, this being put in a covered metal can with faucet at bottom, from which the men filled their pails. Dope was applied with brushes, and another covered can containing two or three quarts of acetone thinner was used for storing the brushes overnight.

The foreman of the dope department stated that there were about 2½ gallons of dope and 2-3 quarts of the thinner in the building on the night of the fire, together with 5-6 gallons of paints. Dope pails were emptied at night and kept in two metal cabinets.

Fig. 2. The coal pile which may possibly have been responsible for the destruction of the plant.

The first floor of the Metal Shop was used for plating, lacquering, soldering, brazing, etc., while the second floor was devoted to woodworking, principally on propellers. This building stands on foundations of an old brick gasometer, and a reinforced concrete first floor was put on the old walls, thus making a fire-resistive basement for a boiler room.

The Stock Room on the south side of the main building was occupied as a stock room for both the Burgess Company and the Navy, and contained accessories of large value, many of which are very difficult to replace.

Cause of Fire.

The cause of the fire is unknown. There are at least three probable causes, as follows:

(*a*) About one month previous to the disaster, fire was discovered in a 100-ton pile of coal in a fire-resistive bin in the boiler room, and this was carted outside and piled against the wood, tin-clad wall of the Dope Building. The pile extended about two-thirds of the length of the north wall and was not over 5 feet high, there being about 75 tons in the pile on the day of the fire. It was described as "New River" coal obtained from Virginia. This coal may have again heated spontaneously, communicating through the metal-clad wall to the Dope Shed. The pile

was shovelled over on the day following the destruction of the plant, but no conclusive evidence of fire in the coal was found. The metal-clad wall extended into the ground below the bottom of the pile. Thermometer readings in various parts of the pile disclosed unequal temperatures, but it is by no means certain that the fire originated here.

(*b*) Fire may have started spontaneously in the Dope Building from oily rags, but the foreman is quite positive that he personally collected all rags and deposited them in the boiler room before he left that night.

(*c*) Fire may have been due to incendiarism. Following the receipt of an erroneous report, the employees quitted work at 2 p.m. to parade and celebrate the conclusion of peace between Germany and the Allies. The men straggled back about 4 p.m., but were discharged for the day. Some fanatic may have conceived the idea of having a bonfire or rumors say, some pro-German might have used this means of showing his displeasure. Just after 6 p.m. one employee came back stating that his foreman sent him to ring out on the time clock. The watchman allowed him to enter the Main Building, and then, remembering that the man was a newcomer who had worked only two days at the plant, he followed him in and saw him leave the clock and pass out of the yard.

This man was probably out of the watchman's sight for about three minutes. As doors from the Main Building into the Dope Building were locked, it seems unreasonable to connect this man with the trouble. Owing to the practice of shutting down the ventilating system in the Dope Building, the atmosphere of the room was no doubt heavily charged with the vapors from acetone and dope from the wings being dried. Smoking was absolutely prohibited in the plant, and the rule was said to be strictly enforced. Probably the real cause of the fire will never be known.

Story of the Fire.

Two Navy officers and an official of the Burgess Company were the last men to leave the plant. Previous to this another company official showed five naval officers through the plant, they visiting the Dope Shed last. This official is quite positive that conditions here were entirely normal. These men probably left the Dope Building a few minutes after 6 p.m. There were two watchmen, one gateman and a fireman on duty. The watchmen lock up, etc., between 6 and 7 p.m., and start making clock records at 7 p.m. Both watchmen were at the gate at about 6.30 p.m., when one of them turned and saw fire in the dope or painting building. He shouted, and both men started for the building, when an explosion took place which seemed to lift one side of the roof and shattered the glass in the windows of the Main Building. These men, together with the gateman and fireman, after turning in fire alarm, got two standpipe hose streams going, but their efforts were unavailing, and one man was badly burned in getting out of main building. A considerable quantity of wings and wing material was stored on and suspended from roof trusses of the Main Building, and this, with the partly assembled wings, aeroplanes, cloth stock, etc., on the floor pro-

Fig. 3. Unprotected steel columns, girders and trusses failed under the great heat.

vided readily combustible material for a rapid spread of flames. According to the watchmen, the rapidity with which fire spread over the Main Building was unbelievable. Before the firemen started, fire had spread to both the Stock Room through the large open passes and across the 6-foot space to the Metal Shop; also to the large boat shed near the Stock Room. There were some very valuable yachts here.

There was some delay in the arrival of the local firemen, who were expecting to parade in the evening, and the starting signal was to be sounded on the fire whistle. When the alarm was sounded, many thought at first it was for the parade, fire alarms not being very frequent in Marblehead.

Outside aid was summoned from Lynn, Salem and Swampscott, and in all there were five automobile pumping engines used, with a total of 12 or 13 streams, part of which were hydrant streams, however. The firemen were handicapped by lack of hydrants, some of the lines being 800 feet and 1200 feet long, while the usual mistake of using small nozzles (⅞-inch and 1-inch mainly) was made.

The water supply was fair, but one of the pumps on a dead-end main had some trouble in getting sufficient water. Water supply is from a 518,000-gallon standpipe and pumps with a total capacity of 4½ million gallons. These pumps were kept in operation throughout the fire. Nor-

mal static pressure is 70 lbs., but during the fire pressure dropped as low as 10 lbs. Hydrants in this vicinity are fed by 6, 8 and 10-inch mains.

The firemen were powerless in face of the tremendous heat, and the roof of main building soon fell in, sinking slowing as the steel roof trusses failed.

The light plank on timber metal shop withstood the fire far better, and in fact two-thirds of the building was left standing, though badly burned.

The Stock Room Building collapsed, as did the Dope Building, but the Stock Room Building received very little water, as the two streams used on this building were 1200 feet long and pressure was very low. The small lumber shed adjoining the east end of the Dope Building had one end burned off, but most of the mahogany lumber stored here was saved. The reinforced concrete dope vault survived the fire unscorched, as did the old dwelling and its brick "lean-to" in the yard. The same is true of 68 drums of acetate dope piled in the yard near the Dope Building.

The fire practically burned itself out with the exception of the Metal Shop, and here the reinforced concrete floor over the boiler room saved the contents of that room. Part of the building still stands, but there will be little or no salvage on contents of first and second floors.

Lessons of the Fire.

A standard sprinkler system would undoubtedly have saved the plant and prevented interruption of a war contract, but the rapidity with which the flames spread show not only the necessity of water supplies of high pressure and great volume, but the need of effective fire cut-offs either by ample spaces between buildings or by brick fire walls.

The susceptibility of unprotected steel columns, girders and trusses to heat from a hot fire is strikingly illustrated and hardly needs comment.

The Dope Shed should be located at a safe distance, or at least be well cut off from other buildings.

The fact that an explosion took place early in the fire indicates that Dope Building should have positive ventilation at all times whether plant is in operation or not.

Fires in which there was Loss of Life.

These notes are intended to point out conditions under which loss of life occurs, that they may be known and guarded against.

S-20886. Smokeless Powder Works. After powder had been run through the final press building, it was taken to the solvent recovery building in order that the ether solvent might be recovered. The solvent recovery building was a one-story frame building, joist construction, having a battery of tightly enclosed wood, metal-lined recovery tanks, all apparently well grounded, running lengthwise through the building. The building had an automatic sprinkler equipment, but there were no sprinklers inside the powder bins. The powder was elevated in cans, each containing 90 lbs., by an outside motor-driven hoist to the top level of the powder bins, and was then carried inside, the powder being dumped through hoppers into the tanks or bins. Hot air was turned into the bins and the ether solvent driven into a brine cooled condenser. The hot air was furnished from outside well-arranged blower and coils.

There were six men in the building at the time of the fire and two at work outside. Of the men inside, four were on the ground floor, one was wheeling powder into the building from the motor-driven hoist, and the sixth was inserting a "thief" into a powder bin. The "thief" consisted of a brass cup on a long wooden pole, a chain being attached to the cup. The device was driven down into the powder, the weight of the powder holding the cup down, and the wooden pole was then removed. The cup was drawn up by means of the chain and the powder taken to the laboratory as a sample. Suddenly the entire contents and structure "went up" in one large flash. One of the men was instantly killed, the other five in the building died within a few hours, and the two who were at work outside were severely burned. The sprinkler equipment was of no value, as the fire spread practically instantaneously.

H-12781. Mercantile. This was a frame country store. A small switchboard was operated in the building, and it is believed that lightning entered over electric wires and set fire to goods. The owner, who slept in an adjoining room, was awakened by hearing goods fall from shelves, and found the whole interior a mass of flames. Five people were in the second story, two of them being of great age. The structure was a total loss, as all efforts were devoted to trying to save the occupants. One life was lost.

S-21361. Automobile Works. It was customary to allow 25 minutes for dipped parts to drip before being placed in the enamel ovens. On the day of the fire, however, the foreman was somewhat behind with his work. He ran out the previous "bake," and, without allowing the oven to cool or the parts to drip properly, he placed the latter in the

oven, closing the doors as well as the vent in the top in order to raise the temperature as rapidly as possible. It was reported that the electrical heaters were at a bright glowing heat when the doors were closed and that some of the employees, recognizing the danger, went away from the oven. Within eight minutes a terrific explosion occurred, demolishing the oven, killing two men outright (including the foreman), and burning three others so badly that they died within a short time. Nearly all the windows were blown out of the top story of the building.

S-21484. Pyroxylin Plastic Factory. Fire occurred in mixing room. A mixture consisting of pyroxylin plastic (composed of nitrocellulose or nitrated stock-camphor and denatured alcohol, with zinc oxide for color) was placed in a sheet-metal mixer very similar to the machines used in bakeries for bread-mixing. The cause of the disaster is unknown, but it may have been frictional electricity. It was stated that there was trouble in starting the machine owing to the slipping of a belt, and that the foreman was sent for. As he was trying to remedy the trouble a flash occurred. Five men were in the room at the time, of whom two were killed immediately, two died after being taken out, and one lived only for a day or two. Sprinklers operated and practically extinguished the fire with small loss to building and contents.

S-21679. Chemical Works. A violent chemical reaction in a nitrating kettle resulted in a pressure so great as to blow out the gaskets at the top of the kettle, allowing the material from the kettle to discharge and ignite. The employee operating the valves, etc., at the kettle was fatally burned. It was stated that an unsatisfactory batch of binitrochlorbenzol had been produced in this kettle a day or two before the fire, and the theory was advanced that the nitrating process was carried beyond the desired point, and that some of this batch, probably containing higher and less stable nitrates than usual, was deposited on the upper part of the kettle. When the attempt was made to put the kettle in service again, the usual charge of mixed acid was drawn into it, but soon after the chlorbenzol was permitted to flow in, the accident occurred. It should be added that a 2½-inch blow-off valve was open at the time, but that this did not avail to prevent the blowing out of the gaskets. Sprinklers practically extinguished the fire and the property damage was small.

S-21882. Mattress Factory. This fire was probably caused by an employee smoking in the silk floss room. It originated in storage bins in that room, and the automatic tin-clad door in a tile partition did not operate quickly enough to prevent the flames communicating to the filling room. Sprinklers practically extinguished the fire, but three employees were burned while making their escape, one fatally and two very severely.

H-13316. Tenant Manufacturing. The building in which fire originated had brick walls with unprotected exterior openings; flat roof, boards on joists, covered with composition tar and gravel; floors, plank on joists, supported on wood beams and cast-iron columns; ceilings, lath

and plaster, with a blind attic in the third story. It was two and three stories in height, with a basement in rear, and the vertical openings were not enclosed. Its area was 13,000 square feet and there were no fire divisions. The flames spread with great rapidity, being aided by inflammable contents, light and highly combustible partitions and the unprotected openings already mentioned. Within about 30 minutes after the arrival of the fire department the entire building was a mass of flames and the roof had fallen in. The efforts of the department were now directed to saving an adjoining fire-resistive building. This structure was originally five stories in height, but an additional five stories were being added at the time of the fire. Reinforced concrete stairs from the eighth to the tenth floors had been poured less than 15 days, and the brick supporting wall for the midway stair landings had not been built, nor had wood forms and supports been removed. The roof columns and slabs had been poured about 15 days previously, and forms and supports for these had not been removed.

Although the exposed openings in the fire-resistive building were protected by approved wired glass in metal frames, the intense heat softened the glass to such an extent that it dropped from the frames from its own weight and also because of the failure of several of the metal window sash, probably due to poor construction and improper riveting. The fire department not being provided with a water tower, it was impossible to bring adequate streams to play on the top floors. The wood scaffolding and wood forms and supports took fire on the tenth floor and, later, flames broke through the wired-glass windows on the third, fourth and fifth floors about the middle of the building. Burning timbers fell from the tenth floor down a light shaft and, breaking through wired-glass windows and skylights, set fire to the contents on those floors. Two lines of hose were connected to the siamese outside standpipe connection in the rear of the building, and it was then discovered that the top section of pipe on the fifth floor had been removed when work on the addition was started. Hose was then carried up the stairway and the fire gotten under control, but with heavy water damage on the lower floors. The concrete stair on the ninth and tenth floors gave way while firemen were carrying hose to those floors, and carried with it all stairs below to the basement, causing the death of two firemen and injuries to others. The loss on the building in which the fire started was total; in the fire-resistive structure the damage to building and contents was estimated at $105,000.

S-22132. Department Store. In the basement of this department store there were two power and heating boilers using crude petroleum oil instead of coal for fuel. It was customary to use the boilers alternately, day by day, unless it was extremely cold, in which case both boilers were operated together. Repairs became necessary in one of the boilers, and after they were completed the oil burner under this boiler was started and the steam pressure raised to 125 lbs. There was a pressure of only 100 lbs. on the other boiler, and it was thought best to equalize the steam pressure in them before opening the intersecting steam valve. Oil was accordingly shut off at the burner under the re-

paired boiler so as to allow the pressure to fall to 100 lbs. It was intended then to relight the burner and to open the steam valve. It is believed that the fireman opened the valve in the oil pipe supplying the burner which was not in operation, but omitted to light the oil, expecting that the heat from the brick in the fire-box would be sufficient to cause ignition, as had happened many times in the past. In this he was mistaken, the brick work being only hot enough to cause oil gas to be generated. Apparently the damper was closed and the gas collected in the fire-box and boiler flues. The fireman then seems to have applied a flame of some kind, and immediately the gas ignited, causing an explosion which blew open the fire-box and ashpit doors and sent a burst of flame into the boiler room. Several oiled surfaces caught fire, including the oiled clothing of the two firemen, who were so badly burned that they died in hospital a few days later. The engineer sustained serious injuries from a fall when making his escape after shutting down the oil pump.

This fire emphasizes the desirability of attaching notices to the front of oil-burning boilers warning employees not to ignite oil under the boiler until the boiler flue damper is wide open so that it may carry off oil gases and thus prevent explosions.

S-22211. Electric Lamp Factory. The plant used several million feet of gas yearly, and two very large gas meters were installed in a room in the basement of one of the buildings. This room was about 20 feet square and 12 feet in height, and was enclosed in brick walls, the foundation of the building forming two sides. Electric lights in the room were turned on by outside switch. Besides the meters, the room contained a rotary gas pump, driven by an electric motor and used for boosting the pressure of gas in the factory lines. The pump had a packed joint on revolving shaft, and it was difficult to keep this gas-tight as it should be.

On the day of the explosion a workman noticed gas leaking and called the master mechanic. Shortly afterwards an explosion occurred which broke a large number of windows in neighboring buildings and lifted the ceiling of the meter room about four feet, wrecking it. A wooden door inside the meter room was also shattered and blown out, preventing the closing of the rolling lift door which was also installed at the opening and the link on which was either fused or ruptured. The damage was heavy, but no fire resulted. Eight sprinklers were ruptured, those in the meter room being broken off, leaving the threaded portions in the pipe couplings.

The body of the master mechanic was found just outside the door of the meter room, where it had evidently been hurled by the blast. A burned match was found by the body, and, as matches are not used in the building, it is thought possible that the dead man had lighted one when he went into the meter room. It is also possible that the explosion was caused by the backing up of a motor truck, with its engine running, near the ventilating window of the room, or by the motor used to drive the gas pump.

S-22523. Garage. While a driver was filling the tank on a motor truck from a five-gallon can, there was a sudden flash and the can exploded, as did also the tank soon afterwards. The accident was attributed to static electricity generated by gasoline flowing through a chamois filter. The man was thrown to the floor by the force of the explosion, and was so badly burned that he died in hospital a couple of days later.

S-22642. Aluminum Bronze Powder Works. Aluminum bronze powder of several grades was manufactured by pulverizing scrap aluminum in a stamp mill. The product was graded for size in a sifting room and subsequently polished. The finished powder was packed in cans and drums for shipment, and at the time of the fire there was some stock in open boxes awaiting packing.

On the morning of the fire, owing to a shortage of certain ingredients, the machinery was not started, and two of the men were set to work in the sifting room to tear down an old brick core oven. There was an accumulation of fine aluminum dust on the top of this oven, and at the second blow of the sledge a spark was struck which ignited the dust. One of the workmen was burned before he could get down from the top of the oven. An alarm was given as quickly as possible and efforts were made to extinguish the fire with sand pails. Being in an awkward place to reach, however, the flames spread to the roof and were soon beyond control. Hose was laid and a stream turned on the passageway between the sifting and storage buildings with the idea of keeping fire out of the latter. Fire doors were closed and a dam of sand was placed around the under side of a fire door between the stamp mill and the sifting building. The town fire department had been summoned, and on arrival laid other hose lines. It is said that they used one stream in the burning sifting building, although they had been cautioned that the use of water on aluminum powder in a finely divided state was dangerous.

In the meantime a belt between the sifting room and the stamp mill had been cut, but fire undoubtedly spread back through this unprotected opening and attacked the dust on structural members of the roof. The mill fire brigade and perhaps some of the town firemen entered the stamp mill with a line of hose, and probably some water was discharged from this. Almost immediately an explosion occurred which badly burned these men, seven dying within a short time and fifteen others being severely injured. A few minutes later a more severe dust explosion took place. The first explosion lifted the roof off the stamping mill and crippled the sprinkler system. After the explosions the firemen were afraid to approach the plant, and the fire was virtually allowed to burn itself out. The property loss exceeded $150,000.

Fire Causes.

The fires here given are selected to illustrate hazards not generally recognized or defects of construction and superintendence in the classes of property indicated.

Electrical.

S-21580. Tenant Manufacturing. The iron pipe conduit containing a power transmission line from the basement to a switch panel and meter on a brick wall at the fourth floor was open at the top. Directly overhead on the fifth floor were several steam-heated rolls used in connection with the sponging of cloth. Water dripped from the rolls and trickled along the wall. Probably the rubber-covering on the wire in the conduit was rotted by the water, causing a short circuit. Fire flashed to the switch panel and meter, but the blaze was practically extinguished by one sprinkler.

S-21711. Cotton Mill. During a severe thunderstorm lightning struck the wires furnishing electrical power to the plant. Cartridge fuses on the line were located in a metal cabinet on the wall, the electric meter being directly below. It was the custom, when the factory ceased operation, to throw off the current at the machines, but to leave the main switch closed. The plant was not in operation when the fire occurred, and the lightning passed through the main switch to the meter, which was destroyed, sparks from it falling onto cotton on the floor. The damage amounted to $1,468.

If the main switch had been opened when the plant shut down the loss would have been slight, if any.

S-22371. Munitions Factory. Fire was apparently due to a breakdown of the insulation of the conductors inside the metal case of the auto starter, caused by an extreme rise in the line voltage. The resulting arc either burst the oil tank or forced the burning oil out of the case and ignited the wooden support for the starter and a partition nearby. The incoming supply line was protected at its entrance with an oil-immersed switch, having an automatic overload release attachment. This, however, was either adjusted too high or failed to operate. The fire occurred at 2 a.m. during the "off peak" period. Abnormal increases of voltage had previously been noticed at night.

S-22614. Cotton Mill. Someone had pulled off an extension cord and fixture from a dropped electric light connection, leaving the bare wires exposed. A sweeper in cleaning the ceiling and wire short-

circuited the open end. Sparks set fire to the lint on his broom, which he immediately dropped on the floor, where flames spread rapidly over parts of four slubbers. Cloths tacked on the ceiling to collect oil from the floor above aided the spread of fire along the ceiling. Five sprinklers operated and practically extinguished the fire.

S-22624. Cotton Mill. Linemen were installing a new transformer post outside the mill. The chain fall used for raising the transformer into position came in contact with high voltage wires, causing a short circuit. Current ran into the mill to an open switch, where it caused an arc, destroying the switch and scattering hot particles of copper which ignited an accumulation of lint in the belt box from a motor. The loss was $658.

Stove.

S-22395. Restaurant. Fire occurred in flooring under a gas range in the kitchen. The single board floor under the stove was covered with about an inch of cement composition flooring, and the stove was set on an iron frame which raised it about four inches. The base of the stove was, however, enclosed by metal, thus allowing no circulation of air beneath. It was holiday season, and the range had been in practically continuous use all day. It is believed that the heat in the confined space under the stove became intense enough to penetrate the composition floor covering.

Inflammable Vapors.

S-21471. Printing Ink Works. On the first floor of one building were located three steam-heated rotary mixers in which varnish, colors, etc., were mixed, the product discharging through a pipe down to the basement of another building where there was a large iron receiving tank. The hot mixture passed through a fine sieve before going into the tank, and while each batch was running an employee stood by, hoeing the thick portions through the sieve in a similar manner to that of a plasterer mixing and straining his final white coat. About five feet distant from the tank was an open gas light. The process had been conducted in the same way for years without accident, but on the day of the fire either vapors from the tank or splashings from the mixture combined with the gas light to cause a sudden fire in the tank. The employee was badly burned, but sprinklers operated in time to prevent much damage to property.

S-21959. Printing Establishment. Type forms were being washed in a metal pan containing a water solution of a proprietary cleaning substance, which had, however, no volatile or inflammable constituents. The pan had previously been used for washing with kerosene. Some of the kerosene remained and collected on the top of the water, The pan was heated by a small gas stove on the floor. The heat apparently vaporized the kerosene and a flash fire occurred. One sprinkler operated and extinguished the blaze. The loss was small.

Miscellaneous.

S-21524. Wool Storehouse. The stock house in which fire occurred was used exclusively for storage of wool in bags and bales piled from three to twelve feet high. For several days employees had noticed a peculiar smell, but they were unable to locate the cause. They decided to investigate, and at length discovered a little smoke and considerable heat coming from one pile. On opening the pile up, they found in the center a quantity of wool deteriorated to a considerable extent from spontaneous combustion. About fifty bales had been more or less affected by the heat. The damage was estimated at $2,500. The only probable explanation was that a bale at this point was wet and that spontaneous combustion had occurred in the jute bagging in which the wool was received.

H-13135. Dye, Bleach and Finishing. The roof boards of a new building had been covered with tarred paper and the larger portion of the paper had been covered with a prepared material which was spread by using a special heating device made of sheet-metal, in which oily rags were burned. The sides, end and top of the apparatus were perforated, and a spark passing through one of the openings ignited the tar paper. A heavy wind was blowing at the time and the fire spread rapidly over the roofing, which, having been placed over the boards only three days, had not become set. The loss exceeded $1,200.

H-13181. Glass Warehouse. The cause of this fire could not be definitely ascertained, but the conditions prior to the fire speak for themselves. A 6,700-gallon tank for fuel oil was buried in the dirt floor of the warehouse, and this was filled from a tank car backed into the building. The glassware stock stored in the building was packed with straw in barrels, these being piled two and three tiers high. A considerable amount of oil-soaked straw was lying on the floor in the vicinity of the tank. The loss was heavy.